STATE OF CALIFORNIA
CALIFORNIA ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF ENVIRONMENTAL HEALTH HAZARD ASSESSMENT

THE EMERGING ENVIRONMENTAL CHALLENGES PROGRAM

FACT SHEET

JANUARY 1998

The capability to anticipate problems that may emerge in the future represents a potentially powerful planning tool for California's environmental protection programs. The Emerging Environmental Challenges Program arose out of a recognition within the California Environmental Protection Agency (Cal/EPA) of the significant benefits that may be derived from early efforts to prevent the occurrence or minimize the adverse impacts of future problems, and to take advantage of future opportunities.

Goal

Under the program, Cal/EPA's Office of Environmental Health Hazard Assessment (OEHHA) will develop the scientific capability to identify environmental issues that may pose challenges to Cal/EPA boards and departments over the next five to ten years.

The goal of the program is to provide, to the policy-makers in Cal/EPA and its boards and departments, science-based forecasts on environmental issues that are within their regulatory purview.

Significance of program

The Emerging Environmental Challenges Program will generate information that will enhance Cal/EPA's ability to take proactive efforts to protect public health and environmental quality.

In addition to generating information on future environmental issues, significant benefits can also be derived from efforts under the program to involve staff and managers in Cal/EPA, as well as external interested parties, in discussions that focus attention on the future.

Implementation

Implementation of the program will involve:

- Identification of possible emerging environmental challenges;
- Classification and screening of issues identified;
- Analysis of issues; and,
- Communication of findings to the Secretary for Environmental Protection and the Executive Officers of the Cal/EPA boards and departments.

In conducting these activities, the program will constantly explore ways by which scientific data, methods and tools may be used to foresee future environmental challenges, and to measure or monitor changes in conditions and/or factors that may signal the emergence of an issue. Throughout the process, input from the Cal/EPA boards and departments will be sought to ensure that efforts are properly focused and relevant to their planning needs. There will also be a number of opportunities for public input.

Identifying possible emerging challenges	Identification of possible emerging environmental challenges will be carried out by soliciting ideas from individuals within, as well as outside of Cal/EPA, and by scanning literature and various other information sources. As a first step in the program, a scientific workshop will be convened to engage environmental science professionals with diverse interests and backgrounds in discussions regarding possible future challenges to the environment.
Organizing and screening challenges for further review	The information obtained from the identification step will be systematically compiled, organized and maintained. Keeping track of information gathered by the program will enable Cal/EPA to revisit at a future time those issues that had been previously deemed not to be of significant interest. Screening criteria will be developed and applied in order to select issues which merit full characterization.
Analyzing emerging challenges	A few issues will be explored in detail as the subject of issue-specific reports. Among other things, these reports will cover: the scientific data, methods and analysis supporting the designation of the issue as an emerging environmental challenge; identification and characterization of the "drivers" affecting the trend, development or event leading to the challenge; identification and characterization of the consequences of the trend, development or event, and their interactions; identification of "indicators" -- changes in conditions and/or factors that may signal the emergence of an issue; and potential options for preventing or mitigating potential adverse impacts of the challenge or for taking advantage of potential opportunities it presents.
Communicating findings	The issue-specific reports will be summarized for incorporation into a "briefing book" for the Cal/EPA Secretary and the Cal/EPA Executive Officers, Board Chairs and Department Directors. Summary reports of the information collected (e.g., from workshops or from literature scans) may also be incorporated into the briefing book. Information will also be made available to interested external parties in order to stimulate input and feedback and to provide opportunity for public scrutiny.

SUMMARY OF EMERGING ENVIRONMENTAL CHALLENGES IDENTIFIED BY WORKSHOP SPEAKERS

Speaker	***Emerging Environmental Challenge(s) Identified***
Genevieve Matanoski, M.D., Dr.P.H.	In addition to citing the recommendations of the U.S. Environmental Protection Agency Science Advisory Board on the five potential overarching problem areas related to potential future environmental issues (sustainability of terrestrial ecosystems; non-cancer human health effects; total air pollutant loadings; non-traditional environmental stressors; and health of the oceans), Dr. Matanoski listed the following: • the long-term consequences of human consumption of bioengineered plants, as well as the effects of these on the natural environment; • the adverse consequences of current water management practices; and, • the implications of our aging population, in terms of housing needs, and drugs excreted and released into water supplies.
Session I: ENVIRONMENTAL IMPACTS OF NEW TECHNOLOGIES	
Wendy Schultz, Ph.D.	• The trans-disciplinary nature of new technologies will require more comprehensive evaluation of their potential impacts, which move away from simply identifying "either/or" impacts, examining instead both the positive and negative impacts (e.g., nanomachines used to "mine" landfills and "scrub out" arteries clearly have beneficial impacts, but what if they get loose in the environment? Will their "intelligence" allow for easier retrieval, or equip them with the ability to flee from their "hunters"?). • There will be a blurring of the borders between the natural and the artificial, or between the evolved and constructed, as in bioengineered plants cultivated in areas where they previously could not be grown – is this the equivalent of introducing an "alien" species?
Terry Surles, Ph.D.	The consequences of advanced energy technologies will need to be constantly examined from a multi-disciplinary perspective; new technology designed to improve one area may have adverse unintended effects ("dangling consequences") in another, e.g., the increased use of biomass for electricity generation may lead to air quality and water resource impacts.
Daniel Sperling, Ph.D.	Many options are available for addressing the adverse environmental impacts of motor vehicles, and public policy plays a significant role as a driver in effecting more environmentally benign technologies.

Speaker	*Emerging Environmental Challenge(s) Identified*
David Zilberman, Ph.D.	Government policy and regulation need to provide the right incentives for the development of agricultural technologies that are environmentally beneficial, such as precision technologies that allow for more efficient water use or reduce pesticide drift, and biotechnology products that may reduce the need for chemical control of plant pests.
Session II: SOURCES, RELEASES AND TRANSFORMATIONS OF CHEMICALS	
Yoram Cohen, Ph.D.	• There is a need to develop integrated approaches to assessing regional contaminant distribution, exposures and health effects which sufficiently incorporate: (1) models simulating chemical movement across various media that consider microphysics, detail chemistry and topography; (2) considerations of population dynamics; (3) characterization of contaminant sources; and, (4) transformation products which are often more toxic than the parent compound. • There is a need for fate and transport models that consist of modular, reusable components, that include a geographic information system (GIS) connection for data on chemical sources and population dynamics in the area of concern, that allow the user to define the environment in question, and that are community-accessible.
Terry Young, Ph.D.	Future non-point source pollution issues include those that are (1) well-known issues that have been difficult to mitigate; (2) issues predictable from current trends; and (3) complete surprises. Meeting these future challenges will require maintaining a diversified portfolio of new tools (e.g., tradable discharge permits, input pricing, performance bonds); early warning systems that assess the health of ecological resources to allow for proactive action; and positioning ourselves so that we are prepared to respond to unforeseeable issues.
Session III: MULTI-MEDIA, MULTI-CHEMICAL EXPOSURES AND RISKS	
Joan Daisey, Ph.D.	• Ideas about risk management are changing, moving away from addressing exposures one chemical at a time, toward reducing “total aggregate risks”; to do this, data on very highly exposed subpopulations are needed, as are ways of grouping agents together (e.g., by mechanism of action, by source or cause, or by inferring exposure metrics using advanced statistical analysis methods to link health effects directly to sources of exposure). • Assessing total exposure will require increased consideration of indoor exposures, given the significant portion of time humans spend indoors, the fact that many indoor sources produce the same health effects as outdoor pollutants, and that chemical concentrations indoors are often two to ten times higher than ambient concentrations. • There is a need for more systematic analyses of the health implications of chemicals associated with new products and technologies that are continually introduced.

Speaker	*Emerging Environmental Challenge(s) Identified*
William Farland, Ph.D.	The more challenging issues in risk assessment include adequately incorporating issues dealing with mechanism of action, sensitive subpopulations and complex mixtures; emphasis and significant advancements in four key areas will be necessary: • research and data collection on interactions in mixtures and mechanisms of action; • databases that will allow the question of mixtures risks to be addressed, including data from interaction studies and guidance in conducting mixtures assessments; • new tools (e.g., artificial intelligence) that will aid in addressing issues of chemical mixtures in the absence of complete data; and, • regulatory approaches that take into account multi-chemical exposures and their potential interactions.
Ronald Melnick, Ph.D.	Future challenges in evaluating the human and ecological risks posed by endocrine disruptors include: • identification of endocrine disruptors and their range of effects; • improved exposure assessments of humans and wildlife; • trans-species extrapolations of animal data or experimental models; • evaluation of dose-response and characterization of effects at environmental exposure levels; • evaluation of risks in sensitive subpopulations; and, • evaluation of risks from mixed exposures.
Session IV: RESOURCE MANAGEMENT AND RESOURCE SUSTAINABILITY	
William Shireman	There will be increasing pressure to minimize loss (costs and consumption), to maximize gain, and to promote sustainability – the goals of industrial ecology; the application of the principles of industrial ecology is changing the nature of environmental regulations from command-and-control to a systems-based approach in which efficiency is rewarded, and consumption penalized.
Andrew Cohen, Ph.D.	The accelerating rate of exotic species invasions into bays and estuaries that has been observed may be a preview of what may happen on land. The mechanisms that transport exotic species around the world are likely to increase in scale as international trade is liberalized, new global markets are opened, and the movement of goods and people increase; these trends will likely introduce organisms that not only affect the natural environment, but also new crop and livestock pests, and human parasites and diseases. In examining the impacts of liberalizing trade, we need to be cognizant of the need to enhance our capacity to prevent, to monitor, to quarantine, to investigate, and to respond to exotic species invasions.

Speaker	*Emerging Environmental Challenge(s) Identified*
D. Peter Loucks, Ph.D.	Water management issues can no longer be solved by infrastructure; achieving sustainability and better water resource management will require modifying our management objectives, eliminating the production of pollutant residuals at their sources, changing production and consumption habits, and having a greater awareness of the long-term impacts of current decisions

INSTRUCTIONS FOR BREAK-OUT GROUP SESSIONS

The break-out group sessions will provide workshop participants an opportunity to present their individual ideas about possible future environmental challenges for Cal/EPA in the next five to ten years.

More specifically, the break-out group sessions are intended to achieve the following **goals**:

1) to collect participants' ideas regarding possible environmental challenges which may confront Cal/EPA in the next five to ten years; and

2) to identify the challenges which are perceived by the group to be of greatest concern, based on impact and likelihood.

Please note that the workshop represents an initial, information gathering step in a process designed to identify, select and characterize future issues for Cal/EPA. All ideas presented at the workshop will be recorded for incorporation into the workshop proceedings, and will be considered, although not necessarily acted upon, by Cal/EPA.

The question:

Cal/EPA's mission is "to improve environmental quality in order to protect public health, the welfare of our citizens, and California's natural resources."

Identify a critical event or trend and the resulting challenge it may present for Cal/EPA in the next five to ten years. Focus on the subject matter assigned to your break-out group. Be prepared to elaborate on how that trend or event and its resulting challenge might occur in the future.

Try to be as specific as possible about the event or trend, and its resulting challenge. For example, it is better to say "continued population growth in California will increase the volume of municipal wastes generated, and consequently increase the need for alternatives to landfill disposal," rather than stating that "California's biggest environmental problem will be population growth." **Please remember that, at this time, we are not looking for proposed solutions to the challenges identified.**

Preparation (10 minutes): Formulate a response to the question above. Use the answer sheet provided (the "snowcard") to write down your response, in the following format (see sample which follows):

Title: A word or phrase describing your response.
Trend or Future Event: A brief description of the trend or future event.
Resulting Environmental Challenge: The consequence or environmental impact of the trend or future event identified.

Please be as clear and concise as possible, and write legibly so that your sheet can be read from a distance. Please use one snowcard for each response.

Presenting ideas (30 minutes): Each participant will get a turn to verbally present his/her idea, providing supporting supplementary information, if desired.

In the interest of time, questions directed to the participant will be limited only to those for clarification. Other participants wishing to express a differing view or to raise additional points can do so during their turn, or by writing down their comment or question on a post-it note, and affixing it next to the idea during the "Pre-voting step" (see below).

As time permits, subsequent rounds of idea presentations will be conducted to capture additional responses that participants have written down. If there are more ideas written down than the allotted time permits verbal presentations on, the discussion leader will collect these for posting on the "idea wall" in the plenary room.

Organizing ideas (ongoing, plus 10 minutes at the end of the presentations): The discussion leader posts each participant's response on flip charts on the wall. After each subsequent idea is presented, the discussion leader asks the presenter whether the idea can be combined with, or grouped with, an idea already posted. The group is also asked for input into the organization of ideas, however, no action is taken without concurrence from the idea originators. The snowcards will be moved around so that similar ideas, or different ideas that address the same issue are clustered together; when appropriate, multiple ideas will be combined into one. As soon as a general heading for a group of ideas becomes evident, the discussion leader will write this on the top of the flip chart. These headings may be changed in the course of the break-out session.

After all participants have had an opportunity to present their ideas, the group will take ten minutes to review how the ideas are organized to determine whether any rearranging is necessary.

Pre-voting step (10 minutes): Participants may affix post-it notes next to ideas on the list that they disagree with, wish to expand upon, or have questions on. Participants are encouraged to walk around the room and discuss ideas amongst themselves. Information in the post-it notes will also be part of the workshop record.

Voting (10 minutes): Participants will be given six "vote dots" to express their judgment about the challenges identified, based upon two independent criteria: impact and likelihood (described below). Red dot stickers will represent impact votes, and green dot stickers, likelihood votes. A participant can distribute the allotted dots among up to six ideas for each criterion.

Determining voting results (10 minutes): For each idea, a score will be calculated by multiplying the total number of impact votes by the total number of likelihood votes. The three ideas with the highest scores will be presented before the plenary group. **The outcome of voting is used only for purposes of narrowing down the number of ideas presented before the plenary group, and is not intended to represent recommendations to Cal/EPA as high priority challenges; all ideas presented will be incorporated as part of the workshop record.**

The criteria:

Participants will be asked to rate challenges based upon two independent parameters, as defined below. A participant will be given six (6) votes each for impact and likelihood, to distribute among up to six challenges for each parameter.

Impact: the power of the event or trend to produce changes in the quality of the environment in a manner that could affect the public health, public welfare, and California's natural resources (**red dots**).

Unexpectedness[*]: the element of surprise, or novelty, of the event or trend (**green dots**).

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STEP	***TIME ALLOTMENT***
INSTRUCTIONS	5 mins
PREPARATION	10 mins
PRESENTING IDEAS	30 mins
ORGANIZING IDEAS	10 mins
PRE-VOTING STEP	10 mins
VOTING	10 mins
COUNTING VOTES, DETERMINING SCORES	10 mins
REVIEW OUTCOME	5 mins
TOTAL	90 mins

[*] Initially, the second parameter was to be **likelihood** (the degree to which the event or trend can be reasonably expected to occur). The change was made at the workshop so as to highlight the more novel ideas, rather than those reflecting already well-known information.

SAMPLE "SNOWCARD"

TITLE: **SECONDARY POLLUTANTS**

TREND OR FUTURE EVENT: **New understanding of secondary pollutants and their toxicity**

RESULTING ENVIRONMENTAL CHALLENGE: **Need to develop approaches to assessing risk which adequately address secondary pollutants, as well as new strategies for controlling or preventing the formation of these chemicals in the environment.**

LIKELIHOOD	IMPACT	SCORE

APPENDIX D

The following is a verbatim compilation of the ideas that were collected during the workshop. The identification numbers ("ID") have been assigned by OEHHA for reference purposes only; the rest of the columns on the table correspond to information that participants were requested to provide during the break-out sessions. In addition to the break-out sessions, participants were also invited to write down their thoughts about future environmental issues for Cal/EPA on an "Idea Wall" posted in the plenary session room. Contributions to the "idea wall" are listed following the table below.

ID	*Title*	*Trend or event*	*Resulting environmental challenge*	*Break-out group*	*Group-assigned category*
1	New environmental technologies	Development of new technologies designed to "clean up" contamination.	Replacing one contaminant with others, or contamination of one environmental medium with another.	*IA*	*Environmental technology*
2	Certification for bio clean-up organisms			*IA*	*Environmental technology*
3	(No title)		Double-walled piping and tanks -- Have some failure of systems -- More regulations will be implemented.	*IA*	*Underground contamination*
4	Landfill liners fail	Landfill liners fail, resulting in groundwater contamination at unprecedented levels.	How to stop leakage; repair/restore groundwater to unpolluted levels; redesign landfills; take advantage of media opportunity to increase waste prevention and recycling activities.	*IA*	*Underground contamination*
5	Extreme traffic congestion	Motor vehicle use and population increases and insufficient public transportation infrastructure = gridlock → air pollution consequences	Public mobility; public transportation	*IA*	*Transportation*
6	Transportation -- inadequacy of infrastructure and failure to compensate for increased emission load; stormwater pollution.	Technology advance will not be able to compensate for the increased pollution (e.g., tire particulates) from the greater # of cars used. Will impact stormwater pollution.	Develop the desire for public transportation using the same consumer techniques that were used to create the "need" for car. Encourage telecommuting.	*IA*	*Transportation*
7	Reuse of treated water from domestic and industrial waste plants		Increased heath and safety risks. Issues will arise, long-term environmental issues.	*IA*	*Water reuse*
8	Water treatment (chlorination, ozonization)	Treatment of water for reuse leads to toxicity, e.g., chlorination of water with natural organic materials leads to highly mutagenic chemicals.	Identifying alternative treatments. [*Comment*: Find ways to improve filtration, coagulation to remove organics prior to disinfection (better pretreatment technology).]	*IA*	*Water reuse*
9	New recycling or re-use	Efforts to divert wastes from landfills or to minimize waste resulting in new widely applied uses.	*Resulting challenge*: Contaminants of reuse or recycled products posing human health hazards or ecological risks.	*IA*	*Re-use/recyclable*

ID	*Title*	*Trend or event*	*Resulting environmental challenge*	*Break-out group*	*Group-assigned category*
10	Dioxin bioaccumulation -- health hazards	Dioxin accumulating in various sinks (land, water biological organisms)	*Resulting environmental challenge*:	*IA*	*Chemical accumulation impacts*
11	1,4- Dioxane	Is ubiquitous. Class B2 carcinogen. Highly soluble, mobile, doesn't biodegrade. Not on toxic list.	Test for and remediate	*IA*	*Chemical accumulation impacts*
12	EMFs	Found to affect people, crops more than previously thought.	Devising a new way to transport electricity and reduce EMF emissions in everyday products (such as sewing machines, computers, microwaves, etc.).	*IA*	*EMFs*
13	Explosion in computer communications	Global communications, Internet, immediate accessibility (pagers, fax)	Increased use of solvents, waste disposal	*IA*	*High tech waste/impact*
14	Disposal of "high tech" wastes	Bioconversion or chemical transformation of a fairly innocuous chemical to a very toxic form that "escapes" the confines of a landfill.	Predicting the changes. arsenic, gallium, transition metals, chlorinated chemicals.	*IA*	*High tech waste/impact*
15	Landfill capacity crisis	As a result of increased use of electric vehicles, the number of batteries being disposed, particularly in SoCal, has diminished capacity.	Recycling battery components? Alternative clean fuel choices need to be developed that don't result in increased disposal.	*IA*	*High tech waste/impacts*
16	Battery disposal -- fuel cell	How to dispose of EV batteries and fuel cells	Landfills, non-point pollution	*IA*	*High tech waste/impact*
17	Trade off of small known risk for unknown risk	Emphasis on using improved technology to reduce present, known hazard (e.g., EVs for vehicle emissions) with system that may simply shift impacts to another location.	Fully analyze integrated, global impacts of new technologies.	*IA*	*High tech waste/impact*
18	Inclusion of all parties in decisions; right to know	Environmental justice, sensitive populations	Inclusive policies; develop tools specific to sensitive groups. Education, outreach, message appropriate to audience.	*IA*	*Public opinion*
19	Media Hysteria	Alarmist reporting/characterization of environmental hazards. Talk radio as a driver of public opinion	Clear, believable, understandable explanations of hazards should be given to the new media and public by Cal/EPA.	*IA*	*Public opinion*
20	Required environment education	California environmental education asks Cal/EPA to devise new curriculum.		*IA*	*Public opinion*
21	Non regulatory incentives	Prop. 1462 bans all new environmental regulations for three years	Economic incentives?	*IA*	*Public opinion*
22	"Cleaner" energy sources....?	Push for less-polluting energy sources	Unforeseen pollutants, resulting from poorly characterized processes (e.g. their out puts); environmental transformations not expected.	*IA*	*Public opinion*

ID	*Title*	*Trend or event*	*Resulting environmental challenge*	*Break-out group*	*Group-assigned category*
23	Noise pollution and species danger from wind farms	New regulations	More use of non-renewable.	*IA*	*Public opinion*
24	Contaminated indoor air	People spending more time indoors, more "air-tight" buildings, and more "new" chemicals used in building materials	Assessing chemicals released from carpets, furniture, computers, etc. Regulating building materials.	*IA*	*Public health (air pollution-related)*
25	Increase in Asthma	Asthma is increasing -- no known explanation	Is this increase related to something in the environment?	*IA*	*Public health (air pollution-related)*
26	Agricultural burning illness	Rice burning (and other crops) may result in cancer or other illness (asthma).	Other uses for crop residues.	*IA*	*Public health (air pollution-related)*
27	"Third disease" (Multiple Chemical Sensitivities)	Minuscule amounts of some chemicals destroy the immune system.	*Resulting challenge*: Monitoring; cleanup.	*IA*	*Public health (air pollution-related)*
28	Emergence of new/exotic organisms	Trend: through ecosystem disruption/destruction combined with population growth and infrastructure decay in the inner cities, we can expect a higher incidence of "unusual disease outbreaks."	Ecosystem conservation, limits to growth and restructuring of inner cities. Require a change of societal norms.	*IA*	*Introduction of Exotic Species*
29	Exotic species	Decline in a food source due to competition from an introduced species.	Selectively controlling or eradicating an exotic species.	*IA*	*Introduction of Exotic Species*
30	Classical biocontrol releases for pest management	Search, research of natural predators, diseases, viruses for weed, insect pest control to reduce pesticide use.	An introduction of alien species into environment. Future ramifications?	*IA*	*Introduction of Exotic Species*
31	Agricultural use of fertilizers	Regulation of fertilizers as pesticides are currently regulated. Continued monitoring and discovery of fertilizers as non point source pollution.	Maintaining high yields of crops to meet demands while keeping fertilizers out of air, soil, water, etc. (may have to plant more acreage - convert rangeland, etc. to meet demand).	*IA*	*New pesticide regulation*
32	Pesticide drift issues	Monitoring, measuring drift particulants (sic) and risk assessment. Zero-tolerance vs. using "due care" to mitigate or minimize drift.	Is any pesticide drift acceptable?	*IA*	*New pesticide regulation*
33	Homeowner/Urban use of pesticides	Regulation as agricultural pesticides are currently regulated or development of better application technology to reduce drift, offsite movement of pesticides from urban use.	Meeting market demands of public (or re-education of pest tolerance levels of the public) to reduce pesticide use. Challenge is to use integrated approach to pest control that is less harmful to environment.	*IA*	*New pesticide regulation*
34	"Organic," natural foods leading to unsafe food	Toxins in natural foods, reducing sanitary procedures (raw apple juice), leading to health hazards.	Balance pros/cons of changing opinions regarding food safety.	*IA*	*Miscellaneous agricultural issues*

ID	*Title*	*Trend or event*	*Resulting environmental challenge*	*Break-out group*	*Group-assigned category*
35	Pesticide tolerant pests	Unable to chemically control a virulent pest (e.g., mosquito or "vector" tick) or a crop destructive pest. Trend: Increasingly poorer control.	Alternative pesticides or biological controls.	*IA*	*Miscellaneous agricultural issues*
36	Pesticide impact on compost	Residual pesticides found in compost causing contamination of food supply. Backyard composters using self-generated compost on backyard crops becoming ill.		*IA*	*Miscellaneous agricultural issues*
37	Adverse effect of engineered food products	Possibility for unanticipated adverse consequences of genomes of foods alien with non-naturally occurring genes (this is not classical plant breeding); also the possibility of wild varieties acquiring herbicide resistant genes.	Greater pilot testing and much longer trial period before bringing products to market.	*IA*	*Miscellaneous agricultural issues*
38	Multiple impacts	In five to ten years, Cal/EPA has developed complete methodology for assessing the impact of multiple chemical exposures, i.e., it will be possible to identify every chemical to which a receptor is exposed via all possible routes of exposure. Not only will each chemical be identified but it will be quantified. Cal/EPA's methodology will also include procedures for assessing the risk to the individual from these impacts.	How does Cal/EPA decide which of these impacts are important and must be changed, regulated, promulgated and have limited resources devoted to them.	*IB*	*Enhanced informed public input: How to increase access and education programs*
39	Real vs. perceived risks	Some risks are <u>real</u>; some are only perceived as real. The media contributes to this problem.	How to differentiate between the two and how to convince the public to believe the truth.	*IB*	*Enhanced informed public input: How to increase access and education programs (issue voted #2)*
40	Integrated environmental science education for all K-12	New technology is creating a greater need for knowledgeable voters on a variety of complex issues.	How to increase the content and environmental applicability of K-12 science education so future voters who are non-scientists will be empowered to ask good questions of Cal/EPA, not be slaves of media, and not emotional slaves to opposing groups.	*IB*	*Enhanced informed public input: How to increase access and education programs*
41	Enhance (not just increase) informed public input	Fewer people understand issues; issue frequency and complexity will grow.	Finding funding to develop proactive and directed programs to train teachers and get students involved. How can EPA link with DOE?	*IB*	*Enhanced informed public input: How to increase access and education programs*

ID	*Title*	*Trend or event*	*Resulting environmental challenge*	*Break-out group*	*Group-assigned category*
42	Agriculture - impacts on soil and sediments of intensive agriculture	Agriculture impacts on environment over long periods is not well established, but will have increasing impacts. We're losing "buffer zones." Valley is a closed system - Bay Delta impacts. (population growth, push to limit agricultural drainage)	Maintain productivity with increasing intensity, and the desire to keep food costs down as much as possible. Animal waste, over fertilization, biosolids disposal.	*IB*	*Heightened agricultural soil*
43	Biotechnology	A wide range of products and commodities are being developed at an exponential rate. The next ten years will see new industries with unique environmental challenges. Much of this activity will occur in California.	How to control "gene flow"? How to assess product and environmental safety? How to apply the risk assessment paradigm? Where to "draw the line"?	*IB*	*Biotechnology challenges*
44	Plant genetic engineering/biotechnology	Transgenic plants will grow in areas/ecosystems previously not suitable to plant (i.e., plants made water tolerant, etc.); resistance genes passed on to weeds/non-desired plants.	changes in ecosystem/ecosystem composition; effects on wildlife, etc.; need to evaluate all consequences of using transgenic plants; develop methods to evaluate inputs; changes in plant gene pool (paucity of genes).	*IB*	*Biotechnology challenges*
45	Self-created alien species	Genetically tailored organisms (e.g., for trash digestion, medical uses, etc.), plants (bioengineered for agriculture), or animals (transgenic for research) get loose in environment.	Damage to native local life -- self-inflicted "alien species" invasion.	*IB*	*Biotechnology challenges*
46	Abandoned mines/acid mine drainage (AMD)	Abandoned mines and acid mine drainage continue to be a huge problem; however, site clean (sic) closure and/or remediation of these mines in California is somewhat new. Where is funding going to come from. When will work begin on these projects. There are hundreds and hundreds of abandoned mines in California, and if remediation does not take place, water resources will continue to be degraded.	Challenge is to find funding and once funding is provided to remediate/treat AMD so as to protect the environment and ecological receptors.	*IB*	*Mining remediation challenges*
47	Divert abandoned mine drainage away from useable water systems	Abandoned mine drainage contaminated with heavy metals and other undesirable contaminants poses an unacceptable pollution problem to many of our stream and river systems and negatively impacts drinking water.	To effectively establish a mechanism, with procedures and recommended actions, to divert abandoned mine drainage outside of the natural stream and river flow systems throughout the state.	*IB*	*Mining remediation challenges*

ID	*Title*	*Trend or event*	*Resulting environmental challenge*	*Break-out group*	*Group-assigned category*
48	Maintain an adequate drinking water supply for California	Good quality drinking water is a continual supply and demand problem in the State. Availability of sufficient supplies will continue to plague California in the future. Reducing the need for supply enhances all environmental uses of water.	To improve the efficiency of the State water transportation system to southern California to ensure that larger quantities of drinking water that leave northern California end up in southern California -- enclose the system to eliminate the 50% evaporation and seepage loss.	*IB*	*Clean water trade-offs*
49	Technologies for providing clean water/sufficient water	Given increased population growth and trend for development in areas that may have limited water supplies, what technologies (or policies) can meet the needs of the population for clean water, with minimal environmental impact.	Health risks associated with contaminated drinking water, ecological upsets with building at large dams, real estate zoning issues, effects on agriculture.	*IB*	*Clean water trade-offs*
50	Treated wastewater as a product	More people, more demand for water -- especially in California. Currently it is a waste product. Should trend to being a valuable resource.	Appropriate re-use of high quality treated water. How to encourage re-use.	*IB*	*Clean water trade-offs*
51	Nuclear power	To keep up with the rising demand for energy, new or additional nuclear power plants are needed or built.	Potential human exposure in the plant. Nuclear waste generation or disposal. Potential nuclear contamination of water supplies. Decommission of plant at termination.	*IB*	*Nuclear*
52	Clean air vs. clean water	Oxygenates have made it possible to achieve significant advances in air quality in California, via the Cleaner Burning Fuel program. However, oxygenates also present a significant groundwater (and drinking water) potential.	How to balance the two goals of having cleaner air and cleaner water without damaging the outcome of either one, or at the expense of either one.	*IB*	*Air*
53	Landfill mining	Landfills contain resources that can be removed -- harvested -- for use. Especially important for future dwindling resources that can be removed from landfills.	Develop a safe and cost-effective way to enter a landfill and remove resources.	*IB*	*How to mine dumps?*

ID	*Title*	*Trend or event*	*Resulting environmental challenge*	*Break-out group*	*Group-assigned category*
54	(No title)	Disparate impact of new technologies on rural and low income counties and communities throughout California. Will financial resource limitation prohibit new technology acquisition?	Current resource depletion and pollution generating technologies will remain only option to such impacted areas of the state. (*Comment:* Information is increasingly being distributed through the Internet, and the cost of obtaining it is thus transferred to the consumer. This penalizes and disenfranchises low income communities.)	*IB*	*System issues*
55	Availability of highly trained people to operate and maintain high tech approaches	Environmental technologies are becoming more complex as they seek to achieve greater efficiency. At the same time, these technologies become the expected/desired approach to prevention, treatment or remediation. Thus, a rural community will be expected, or even required to use these technologies to operate public works (sewage, water supply, stormwater drainage, irrigation).	The challenge is to have the human resources necessary to understand, operate, maintain and repair the technologies. This challenge is going to be greatest in less populated areas that historically have not attracted "high tech" workers.	*IB*	*System issues*
56	Regulatory paralysis (need an integrated regulatory system to handle an integrated environmental protection program)	Current and future problems, and the evolving emphasis on watershed based management, are not properly addressed in the current regulatory process. The future will require attention to an ever expanding list of environmental challenges. The current system works satisfactorily on a specific identifiable problem, but not on the more complex problems we now face.	How to revise a regulatory system that worked pretty well when the environmental challenges were relatively obvious. We are now faced with highly complex and in some cases emerging (unknown) issues. How does the system modify to focus on systems rather than individual pollutants or stressors. the focus should be on improvement of a situation, once this situation has been prioritized. How to integrate multi-agency responsibilities to address complex issues.	*IB*	*System issues*
57	Decision-making process	Agencies (within Cal/EPA and outside) are inconsistent in the process and not spending enough time developing better decision-making processes for resolving issues.	Refining the risk assessment process. Training people. Filling data gaps (i.e., right kind of research). Improved models.	*IB*	*Process flexibility*
58	Improve the decision-making process to decipher what issues are important to be addressed	Decrease the difficulty inherent to the decision-making process to embrace <u>new</u> ideas that are not already or now easily embraced. Decrease the rejection of ideas that are not already "main line."	This will guide Cal/EPA to address issues that are not easy or main line but which are extremely important with major ramifications to environmental protection and improvement.	*IB*	*Process flexibility*

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59	Allow flexibility to meet severity of the problem	As the success of high tech approaches is documented, there will be a push to mandate their use. However, in certain communities, high tech approaches may not be feasible, due to economics or lack of human resources. Or the problems facing the community may not be sufficiently grave to require new, expensive high tech approaches.	To allow for flexibility. Regardless of how efficient a technology may be, it is not wise to mandate its use for all; there will always be exceptions.	*IB*	*Process flexibility*
60	Reuse/recycling of computer materials	Computers, disks, micro-chips and other associated materials will become a greater percentage of the wastestream. Computer technology is projected to expand more and more into our daily lives.	To work with the computer industry in the design of hardware and software, so that computers and associated materials are reused or recycled.	*IB*	*New waste streams (issue voted #3)*
61	Reuse/recycling for changing wastestreams (new automobile fuels)	New fuels, such as nickel-cadmium batteries for car energy, will need to be safety handled and recycled to reduce what will probably be a significant wastestream.	To work with manufacturers in the design of these batteries to enable recycling or reuse of the wastes.	*IB*	*New waste streams*
62	Discarded "toys"	Proliferation of small electronics, eminently discardable.	High level of high tech in the trash/in landfills. Toxins?	*IB*	*New waste streams*
63	New materials and processes create new wastes	New technology, such as the creation of new materials and processes, will create waste and disposal products about which we have no toxicological information and which are unidentified and unregulated.	How to track and identify the chemical products which could become widely distributed in large quantity before an environmental problem has occurred. How to identify the bad actors.	*IB*	*New waste streams*
64	Failure of current technology	Current technologies that are promoted today could become the problem tomorrow; example - failure in landfill liners.	To have fallback position to address potential technological failures in future.	*IB*	*Not categorized*
65	Public involvement	Demand for public involvement in environmental decision making by government is increasing especially in the choice of technologies used.	Finding ways to address the public's concerns while still developing scientifically sound and economically feasible technology solutions to environmental problems.	*IC*	*System diagnosis and communication*
66	A politically buffered network of "sentries," "scouts" and "analysts" to detect emerging reality regardless of agency turf.	Increasing politicization of science and increased public distrust.	If we cannot obtain an accurate holistic view of the system, we will (a) over-react; (b) under-react and act in an uncoordinated way in response to isolated symptoms, not root causes.	*IC*	*System diagnosis and communication*
67	Transportation fuels/additives	Increase population, increase demand for flow of goods and people.	Increase pressure on air quality, water quality, disposal issues.	*IC*	*Transportation*

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68	Fuels characterization	New additives in gasoline, new alternative fuels	Requires complete life cycle analyses for fuels (comparative analysis)	*IC*	*Transportation*
69	(No title)	Refining of oil from poorer quality oil	New wastestreams	*IC*	*Transportation*
70	Battery/fuel cell powered cars	Increased use of ZEVs to reduce air pollution.	Used batteries and fuel cells will have to be recycled or disposed of. How hazardous will the waste be and where will it go?	*IC*	*Transportation*
71	(No title)	Increased use of hybrid vehicle with diesel	Increased small particulate pollution	*IC*	*Transportation*
72	MTBE -- groundwater	Continued contamination -- closing of wells -- technology for clean-up	Clean-up how? With what? Who does it? Air Board position? Support of oil industry	*IC*	*Transportation*
73	Dioxins -- pollution in state waters	Continued concerns -- build up from diesel, other fuels	How to clean up, remove	*IC*	*Transportation*
74	Localized wastewater treatment technology	Increasing urbanization requires increasing sewerage and wastewater treatment facilities. New chemicals/drugs in use will eventually get into our water bodies. Impacts: high costs and uncertain environmental, health, ecosystem impacts.	Can't we find a way to completely reduce/recycle all wastes now being transported by water? NASA does this in space. We need to give serious thought to designing technologies for smaller, self-contained (within household or industry), cost-effective waste treatment units. If successful, the impact would be enormous.	*IC*	*New technology*
75	Deregulation	Deregulation of electric power industries.	More companies involved in power generation will result in more competition which results in more environmental short cuts.	*IC*	*Regulation/market*
76	Earthquake toxic fires prevention and preparedness	50% probability in Richmond	Avoidable morbidity	*IC*	*Not categorized*
77	Selenium -- effect on fish	Health problems continuing; identify sources; increase solutions	Clean up -- remove sources	*IC*	*Multi-source water issues*
78	Contamination of agricultural land groundwater	Current practices lead to selenium, nitrate, heavy metal contamination, salt water intrusion	Development of new practices/regulations related to groundwater/surface water runoff requires cooperation between Cal/EPA and Resources (Agency).	*IC*	*Multi-source water issues*
79	Recycled groundwater and wide range of potential health and ecological effects	Will need to use recycled water more and more	Drink this water or use as separate gray water systems. Need testing and post-market surveillance.	*IC*	*Multi-source water issues*

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80	Complaints of exquisite sensitivity to multiple chemicals (special case of vulnerable subpopulation)	High current prevalence (16%) and uncertain future trend	If "real," suggests need for new policy approaches; if "perception," will imply research and political challenge. Note genome project will also identify vulnerable subpopulations which will require new policy approaches.	*IC*	*Policy for vulnerable subpopulations*
81	RD&D	Society will continue to "pick winners" -- choose a particular technology -- to resolve problem "X," focusing many RD&D $'s in that single technology without pursuing many options to resolve "X."	Excessive time delays in resolving environmental problems due to sequential attempts at solutions and lack of funds.	*IC*	*Life cycle*
82	Economic barriers to change	What will serve as the catalyst when necessary environmental changes have powerful economic barriers	Economic resistance to change. Answer is possibly Terry's suggestion that it lies in regulation. But doesn't this have to be U.S. regulation.	*IC*	*Life cycle*
83	Lack of comprehensive analysis	Overly focused development of technology to resolve problem without fully evaluating range of potential impacts of products.	Unforeseen secondary impacts, that may be worse/as bad of problems as that originally addressed.	*IC*	*Life cycle*
84	Material recycling	Can the wastestream associated with new technologies be minimized or recycled?	Increased burden on landfills, toxics-related problems -- if not dealt with.	*IC*	*Life cycle*
85	(No title)	Evaluating new technologies	Concern about cost and ecological issue for developing products but not their disposal	*IC*	*Life cycle*
86	Communicating scientific data	The average Californian doesn't seem to believe scientific data that demonstrate early warning signals or potential problems. How does Cal/EPA raise public awareness?	No commitment to change.	*IC*	
87	Failure on advantageous technologies penetrating market	Needed and worthwhile technologies may not be adopted/purchased by consumers (↑ efficient vehicles). Developers may be unable to access potential markets	Continued reliance by consumers on technologies that pollute and use excessive resources.	*IC*	
88	Disincentives to technology break-throughs	Regulatory development is usually evolutionary, reflecting generally linear sociocultural developments. Technologies, however, are capable of developing much more rapidly than social change. These disparate rates of change lead to barriers or disincentives to breakthrough technology development.	Development of socially acceptable regulatory incentives to develop, transfer, and implement environmental technology breakthroughs.	*IC*	

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89	Life cycle evaluation of manufacturing/P2 process	New technology for existing/emerging manufacturing processes must be developed to reduce, recycle waste.	Development of cost-effective technologies; development of multi-media regulatory approaches; evaluation of externalities (env., econ; manufacturing, public acceptance)	*IC*	
90	Involve stakeholders in options generation and policy analysis first, research and literature review second	Present trend is to use science as an excuse for delay instead of as an aid for choosing between options.	Chemical by (sic)	*IC*	
91	Drugs in wastewater	Aging population, coupled with increasing population, will increase occurrence of excreted human and veterinary drugs that are not broken down at wastewater treatment plants, are discharged.	Need to monitor and do risk assessment on low levels of human drugs; consider adverse drug interactions.	*IIA*	
92	Cumulative effects	Increased use of chemicals in processes, products, and residuals.	Need to assess the cumulative health and environmental effects of increased number and total amount of chemicals used.	*IIA*	
93	Urban agricultural spraying	Urban growth -- land use plans; buffer zones; trust; keeping everything on your farm; total water returns; low plant spray precision; why do we spray pests; discuss weather changes	(Illegible) what they do with their runoff? Leadership. Food shortage; who cooks?	*IIA*	
94	Technology vs. risk-based regulation	Emphasis on risk (including comparative risk) as basis for priorities/resources; need to move from “emission reduction” to “risk reduction”...requiring better risk reduction/benefits assessment.	Refocus of research, monitoring, and enforcement.	*IIA*	*Risk assessment*
95	(No title)	Eliminate non-point source pollution by accounting for all chemicals via GIS.	*Resulting environmental challenge:*	*IIA*	*Risk assessment*
96	(No title)	Advanced technology finds 10,000 chemicals in water	*Resulting environmental challenge*	*IIA*	*Risk assessment*
97	Quick/cheap/easy/available tests and data	Test kits will become available for (1) exposures (e.g., urine tests); (2) risk factors (e.g., genotype/phenotype), and (3) ”effects” (e.g., bioindicators of disease)	Greatly increased pressure/emphasis on individual risk management/protection...greatly complicating policy making	*IIA*	*Risk assessment*

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98	Indoor air sources of exposure; emissions from building products, furnishings, and consumer products used in homes	Types and formulations of products used in homes and workplaces, schools are constantly changing and changing the nature of human exposures to toxic chemicals. One example -- C6-C8 aldehyde emissions from new wood products used in home construction. Formaldehyde emissions way down; other aldehydes now.	(1) Determining if new products pose a human or environmental health risk; (2) Having more systematic ways to evaluate new products before they are released for commercial use and better scientific methods for such evaluations.	*IIA*	*Risk assessment*
99	Effect of poverty on exposure and susceptibility to chemical toxicity	There is evidence that the urban poor are exposed to more pollution from a variety of sources, both mobile and stationary, than other societal groups	The challenge is to characterize the exposure, determine the susceptible subpopulations and to devise workable solutions that do not create new problems. Little is known about activity patterns, residential duration, effect of health status on susceptibility and effects of multiple chemical exposure (i.e., lead and other chemicals)	*IIA*	*Risk assessment*
100	Future environmental problems arising from control measures.	Measures taken to solve some environmental problems may, in turn, unexpectedly cause others. For example MTBE may reduce air pollution but may lead to water pollution.	The challenge is to identify potential environmental problems and health hazards, which could be associated with future control measures.	*IIA*	*Risk assessment*
101	Fuel additives	If MTBE poses too great a cost to the groundwater, new gasoline additives will be introduced to replace it.	Cal/EPA may have to evaluate health and environmental impacts with short deadlines and inadequate data.	*IIA*	*Risk assessment*
102	Aquatic release of exotic species	Increased takeover of introduced species	Specific control measures (by whom?); non-secondary environmental damage from control measures; economically achievable control measures.	*IIB*	*Watershed issues*
103	Watershed PBT contamination	Reduce impacts of PBT chemicals -- such as Hg, PCBs, etc. -- in areas of watershed impacts.	*Resulting environmental challenge:* How to restore to reduce stressor impacts? How to find appropriate replacement chemicals, if necessary?	*IIB*	*Watershed issues*
104	Riparian zones -- can they be preserved and recreated?	Loss of habitat due to grazing and filling of riparian areas -- are riparian areas restorable and recreatable?	Loss is staggering in California -- can we recreate and/or prevent loss?	*IIB*	*Watershed issues*
105	Mercury/selenium -- speciation of pollutants	Historical regulation of totals lead to misunderstandings of treatment.	Understanding how these an(d) others react in the environment -- what forms are in waste and how they can treat it. AND, does it need restrictions?	*IIB*	*Watershed issues*

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106	Mercury release to the environment	Chemical transformation to methyl mercury	Proper disposal of mercury containing products; containment of air disposal of mercury; remanufacturing without using mercury	*IIB*	*Watershed issues*
107	Reducing pollution despite regulatory growth	Population growth (32-41M by 2010). Further demand for housing/goods	Challenge is to reduce sources and releases in the face of increasing demand for goods driven by larger population.	*IIB*	*Regulatory issues*
108	Monitoring the effectiveness of control measures	Control measures are adopted but their impacts are not tracked for extended periods.	Develop a framework for monitoring compliance with a regulation at the time it is scheduled for adoption.	*IIB*	*Regulatory issues*
109	Indoor air	Increased emphasis on indoor climate control (heating, cooling, humidification, etc.) combined with use of more synthetic chemicals.	Indoor air quality is of greater concern than outdoor based on higher levels of exposure to complex mixtures of new chemicals and microbiologicals.	*IIB*	*Indoor air*
110	Ground water contamination	Atmospheric deposition and soil contamination leads to increasing ground water contamination (future drinking water sources)	Treatment of drinking water becomes more complex/expensive especially for small systems and private wells (can be E.J. issue)	*IIB*	*Groundwater*
111	Non-point source/pesticides in groundwater	Continuing regulation of groundwater contaminants on a chemical-by chemical basis	Need to develop mitigation/management practices based on local use practices/soils etc. for chemicals as a "class," e.g., preemergent herbicides. Common physicochemical characteristics and use practices correspond to common pathways to ground water.	*IIB*	*Groundwater*
112	Ground water contamination	Unexpected new contaminants (primarily used for fuels) reaches groundwater	(1) What are the sources? (2) What are the fates? (3) How does the transformation affect needed understanding of risk/clean-up of contaminant?	*IIB*	*Groundwater*
113	Pesticide/medication confusion (start with lindane)	Medical professionals/HMOs specify medications without respect to environmental impacts -- improved analytical techniques will reveal detectable quantities.	Define what is "bad" -- educate medical professionals -- find alternatives	*IIB*	*Education/information dissemination*
114	Public education about...	Environmental issues will become more complex and contentious amid increasing changes in society.	Need to develop improved means of substantively communicating problems/solutions to public through education via media.	*IIB*	*Education/information dissemination*

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115	Internet access to sources and releases	Through the Internet, a large number of Californians could have instant access to environmental release info (e.g., TRI), which could be used effectively to drive pollution prevention.	Make sure info on environmental sources and releases is accurately reported and placed in usable form on Internet.	*IIB*	*Education/information dissemination*
116	Manufacturing is good!	Chemical reaction of multiple chemicals originating at unrelated sources	Devise environmental and business friendly systems that anticipate, plan for and prevent hazardous/toxic reactions recognizing that the industries are unrelated and by themselves add to society.	*IIB*	*Transformation*
117	Pesticide metabolites in surface and groundwater	Recently has become increasingly apparent that pesticide metabolites sometimes occur in groundwater more frequently and at much higher concentrations than parent (x 10 to x 30)	Identify metabolites of pesticides in groundwater/physicochemical properties/presence in ground/surface water and significance --environmental and toxicological.	*IIB*	*Transformation*
118	Creation of resistant bacteria/virus	Increasing use of disinfection (chlorine/ozone/quat) create resistant microbes requiring new chemicals with unknown environmental consequences	*Resulting environmental challenge*	*IIB*	*Transformation*
119	Global change	The oxidizing strength of atmosphere is increasing or will increase	Need to develop means to assess how change will affect air quality management strategies/practices -- more effective transformation of emissions and increased ecosensitivity.	*IIB*	*Global change*
120	Assessment of high atmosphere contamination	Cumulative contamination of high atmosphere caused by emissions from jet engines.	Need to develop approach, analytical methods and long-term forecasting of/for atmosphere contamination of CO/CO_2, NOx, SOx, O_3, and potential impacts on weather/green house effect/world health (O_3??)	*IIB*	*Global change*
121	Emissions and deposition of nitrogenous pollutants	Nitrogen saturation of natural ecosystems, changes in plant communities and groundwater contamination	Develop approaches for quantifying total nitrogen emissions, deposition fluxes, and potential for leaching to groundwater.	*IIB*	*Not categorized*
122	$PM_{2.5}$ impacts	Need to understand health impacts of fine particulates including how generated, how transported, susceptible populations, fate/metabolism in vivo.	How to reduce impacts with specific emphasis on western sources of particulates.	*IIB*	*Not categorized*

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123	Regional air pollution	Impact of urban areas on regional air pollution	Develop accurate emission inventories/estimates along with realistic models capable of forecasting potential problems (e.g., alternative fuels, electric vehicles)	*IIB*	*Not categorized*
124	Ozone and ozone precursors	Understanding, with greater accuracy, the sources of ozone precursor emissions within California	Improving emission inventories, airshed models, and estimates of health and welfare effects -- developing a framework for full cycle assessments.	*IIB*	*Not categorized*
125	New pollutants from transportation	Reformulated gas, alternative hydrocarbon fuels, alternative non-hydrocarbon fuels	Generation of novel chemicals with unstudied behavior	*IIB*	*Not categorized*
126	Multimedia control of dioxin	Need for multimedia control of dioxin, air sources include incineration and exhaust from diesel engines; impacts to Bay and its fisheries from air deposition and stormwater runoff.	Need air/waste/health agencies to assess and develop control strategies; environmental justice issue.	*IIB*	*Integrated approaches*
127	Transformation of Hg to methyl Hg	Mercury fish advisory in SF Bay; methyl mercury in tidal marshes -- what impact on our ability and desire to create more wetlands.	Health impacts of mercury fish advisory; reservoir sources (abandoned mines, thermometers, dental amalgams); how deal with transformation to methylmercury	*IIB*	*Integrated approaches*
128	Exposure to multiple chemicals	Better understanding of interactions associated with multiple exposures. Advances in science	How to assess risks of exposure to multiple chemicals.	*IIB*	*Integrated approaches*
129	Environmental contaminants and quality of life	Health effects (morbidity), cancer or death may no longer be considered reasonable as they are human endpoints of toxicity. We should consider quality of life as expected endpoint.	Need to develop markers or endpoints, or descriptors of quality of life (not toxicity), and human risk assessment focus on these endpoints, no longer toxic endpoints.	*IIB*	*Integrated approaches*
130	Global Change/CSO	Changes in weather patterns may increase frequency and magnitude of combined sewer overflow (CSO).	Ecological and human health impacts of toxics and emerging pathogens in rivers affects use (swim/fishability) and ecological integrity.	*IIB*	
131	Toxic transformation products	Systematic identification of toxic transformation products. Current regulatory approaches do not regulate based on daughter products.	Need to develop a risk assessment approach that considers parent and daughter products and establish a regulatory program that considers the total risks.	*IIB*	

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132	Integrated regional risk assessment for forecasting pollution	Pollutants cross phase boundaries and regional boundaries. An overall/integrated approach should be taken to better understand the short and long-term risks down from multimedia perspective.	Develop integrated multimedia tools to assess integrated exposure/risk in a dynamic environment; the goal is to provide useful information that considers the real-environment yet clarifies existing uncertainties.	*IIB*	
133	(No title)	Human release becomes major pollutant source (feces, urine chemicals, exhalations, noise, allergens, hair and dander, lint from clothes, chrome from shoes, etc.).	How do we better regulate human behaviors and resulting pollution without becoming police state?	*IIC*	
134	Business as environmental leaders	Businesses will become a leader in environmental improvement as they realize the economic self-interest in redesigning both products and production, packaging and distribution processes.	Cal/EPA and the environmental community must learn to communicate about environmental issues in the language of business, return on investment, profit, etc.	*IIC*	
135	Secondary impacts of drugs	Aging population taking more drugs, assuming that current sewage treatment systems do not remove these chemicals before discharge.	Unanticipated impacts on aquatic organisms and other wildlife.	*IIC*	
136	Air sources of water pollution	Air emissions (combustion, vehicles) are becoming the major source of water pollution for key constituents.	How to control air releases to protect surface water.	*IIC*	
137	Sources, releases, transformation of chemicals -- mixtures	Increasing exposure to complex chemical mixtures, either in complexity or magnitude.	To understand (possibly redefine) how we measure how human and ecological populations are impacted by low-level exposures to chemical mixtures; how to monitor emerging environmentally related illness. Move away from single chemical-single effect lab studies.	*IIC*	
138	Pesticide use contaminates water	Pesticides continue to pollute surface water.	Coordination among state agencies to control pesticide use.	*IIC*	
139	Illegal drug labs	Increasingly mobile; turn up in many environments.	Pollution of soil and water	*IIC*	
140	Crop	Growing crops in areas where their maintenance is foreign to the area.	Wise use of water; what is the effect to the area (plants and animals); what is the effect on the indigenous plants and animals, also introduction of new plants and animals.	*IIC*	

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141	Resource valuation	Economic development and land development have built-in ways to capture and recover economic value. Community and public resources, which may compete with economic development, has limited ways of applying and recovering value -- i.e., you can't sell clean air or open space or biological diversity.		*IIC*	
142	(No title)	Increasing ozone → changes in composition of atmospheric pollutants	Identify and decrease.	*IIC*	
143	Emerging problem for EPA: Chambers of Commerce/Development community backlash to environmental legislation/actions	Increasing awareness by business community of how environmental community/laws/rules and actions affect their business(es)/livelihood.	Convince the business/development community that environmental legislation -- Clean Water Act, etc., etc. -- are in their best interest.	*IIC*	
144	Effective transformational action	Americans must perceive a specific and simple "crisis" in order to make environmental action politically feasible.	For each possible risk area, Cal/EPA must: have measured the risk; have created a clear message from the data; be alert for a transformational event; have a broad communication plan ready; have a proposed plan of action ready.	*IIC*	
145	Emerging problem for EPA: react to West County Toxics Coalition of the world -- minorities' belief that they are being unfairly affected by environmental pollution.	Increasing importance of diverse population on environmental decision-making.	Involve/educate these folks.	*IIC*	
146	(No title)	Improved communication causes homogenization of culture -- making entire world a "monoculture," sensitive to disruption.	New disease disrupts entire world; or new food additive; or a new drug...How do we maintain enough diversity for self-protection?	*IIC*	
147	Exotic organism introduction	Ship hull introductions of exotic organisms	Determine ecosystem alteration and develop database.	*IIC*	
148	Ion ratios in surface waters	Increasing or current salinity problems in upper reaches of rivers due to agricultural discharges, combined with new knowledge of the importance of individual ionic ratios as opposed to simply EC.	Decrease salinity inputs below currently anticipated levels.	*IIC*	

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149	Emerging problem for EPA: How to deal with toxic hot spots	Dealing with identified toxic hot spots	Bury them, move them, neutralize them, fence them off and leave them	*IIC*	
150	Cellular level effects by contaminants in marine environment	Reduced vitality of organisms; toxicity responses	New methods to measure and assess DNA damaging chemicals	*IIC*	
151	Legal, political (intellectual property)	Implications of new technology implementation, i.e., bioengineered species, electronic publishing, etc.	Regulatory quagmire resulting in new technology without application	*IIIA*	*New technology*
152	"Losing forest for trees"	New chemicals and new technologies proliferate faster than we can individually evaluate them.	Need "soft decision analysis" and rules of thumb based in science.	*IIIA*	*New technology*
153	Post-market surveillance	Can't foresee all effects of new technology. Need a system of generic post-market surveillance.		*IIIA*	*New technology*
154	(No title)	Desertification/nutrient depletion/salination ruin soils -- is this inevitable?	Intensive agriculture and human effects will result in decreasing productivity of California soils. How will we sustain the agricultural system?	*IIIA*	*Growth*
155	Future growth in California	Future population growth in California due to economic expansion will result in greater use of water table; air emissions; greater load upon coastal zone due to increase in trading; increase in transportation.	Impact upon water sources, coastal areas, air emissions. What will be the cumulative effects?	*IIIA*	*Growth*
156	Increase suburban/agricultural interface	As population spreads to Central Valley, more people will move next to agricultural fields and pesticide applications.	More concerned citizens and perhaps health effects.	*IIIA*	*Growth*
157	Exotic organisms impact	As brought out in the presentation, there is, and will continue to be, an alarming increase in the number of "exotic" organisms that are becoming established in native locations.	How to deal with the environmental, economic and health impacts of exotic organisms in our native locations.	*IIIA*	*Not categorized*
158	Contamination leakage/ spreading from natural disasters	(1) Global climate increasing storm severity of rainfall produce flooding which spreads contamination; (2) Earthquakes breaking containment devices.		*IIIA*	*Not categorized*
159	Leaking underground storage tanks (UST)	Although the UST replacement program is now almost complete, there continues to be a problem with fuel leaks...even from the new USTs.	How to prevent future groundwater contamination from UST leaks.	*IIIA*	*Not categorized*

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160	International cooperation in environmental protection	Cross-national boundary pollution (e.g. Colorado River, global warming, acid rain)	Innovative approach -- e.g. National debt forgiveness and use money for pollution control facilities.	*IIIA*	*New approaches/partnerships/regulatory structure*
161	Change in life style to protect environment; give up convenience for environmental sustainability	Industrial ecology, car pooling waste recycling - separate use for drinking and cooking and for other domestic use; non-water carried waste transport systems	To create technology to promote/create convenience without creating environmental degradation.	*IIIA*	*New approaches/partnerships/regulatory structure*
162	The end of hazardous wastes!	Widespread application of industrial ecology -- encouraged by Cal/EPA regulations -- resulting in all "wastes" generated by any given facility being utilized by another.	No challenge in future; current challenge is to identify approaches or strategies to promote industrial ecology.	*IIIA*	*New approaches/partnerships/regulatory structure*
163	Recognition, understanding and meeting new environmental challenges.	New environmental challenges will emerge that are unexpected, not well understood, and for which answers will require imagination, innovation and resources.	How to recognize, understand and meet environmental challenges that arise in future.	*IIIA*	*New approaches/partnerships/regulatory structure*
164	Environmental protection	Moving toward less government or changing role of government -- from command/control to what?	Achieving equity in moving from command/control solutions to collaborative environmental solutions.	*IIIA*	*New approaches/partnerships/regulatory structure*
165	Integrated regulatory structure	Increasingly complex issues in the environment. Multiple agencies have different focus and responsibilities.	Coordination of agency efforts that work together to develop a better system. Too often there is a conflict of interests.	*IIIA*	*New approaches/partnerships/regulatory structure*
166	Change from command-and-control approaches to environmental partnership (EP) approach	Change is occurring, but only slowly, resulting in mixed approach to resolving environmental issue.	How to accelerate towards EP approach which solves environmental problems with less conflict among stakeholders.	*IIIA*	*New approaches/partnerships/regulatory structure*
167	Integrated environmental protection system	Moving from minimizing problems (waste) to maximizing gains.	The application of ecological principles to industry. How can we incorporate volunteer or alternate (to command-and-control) mechanisms on industry and the general public to promote sustainability. How do we reward efficiency, creativity and innovation rather than penalizing. Sustainability is defined as creating more than you consume.	*IIIA*	*New approaches/partnerships/regulatory structure*
168	Advocate for the Environment Office	Continuing environmental challenges need government office to investigate and promote solutions, draft regulations.	Cal/EPA needs a regulatory office, investigative authority, or will not be able to respond to challenges/problems for the environment.	*IIIA*	*New approaches/partnerships/regulatory structure*

ID	*Title*	*Trend or event*	*Resulting environmental challenge*	*Break-out group*	*Group-assigned category*
169	Improving risk assessment	Develop a species (test) by cloning (or other methods) that will react similar (physiologically and chemically) to humans.	Less cost, better health risk assessments, more credible, decrease risk to the general population.	*IIIA*	*Risk assessment*
170	Risk assessment -- multiple chemical exposure/interactions	Achieving new effective containment in manufacturing, transport and use policies/practices	Identifying alternatives to current practice of examining/studying interactions one, two, ... chemicals at a time.	*IIIA*	*Risk assessment*
171	(No title)	New contaminant discoveries (e.g., perchlorate) -- human and biosphere safety threshold based on science, not political expediency.		*IIIA*	*Risk assessment*
172	Chemical interactions	To estimate chemical interaction in the body we will be going to the use of models instead of actual testing.	No model is 100% accurate. If we use modeling on a large scale for the thousands of chemicals, how do we prevent missing the important exceptions that miss hazardous chemical combinations.	*IIIA*	*Risk assessment*
173	Multiple chemical sensitivity disorder	Combinations of various chemicals triggering a breakdown of the immune system.	Multi-chemical exposure analysis/modeling; monitoring	*IIIA*	*Risk assessment*
174	Risk assessment	Trend is to use this type of analysis for chemicals and/or groups of chemicals.	Use a similar type of an assessment to determine the priorities in the watershed or environment. The priorities can then get an adequate allocation of resources. The challenge is to address all issues with limited resources.	*IIIA*	*Risk assessment*
175	Light pollution	Increasing urbanization and temporal distribution of human activities is leading to increasing light pollution impacting on both human health and the health of wildlife.	Addressing the chronic human and ecosystem health issues associated with human activities generating light pollution.	*IIIA*	*Risk assessment*
176	Unilateral public acceptance of risk-based decision-making	Some sectors see risk-based decisions (e.g., standards, etc.) as a license to pollute whereas others view this approach as too restrictive and unrealistic	Agencies need to be more pro-active in: (1) promoting the scientific advances needed, and (2) educating the public as well as political bodies. The challenges are how to do this effectively.	*IIIB*	*"New" approaches to management*
177	"Shared vision" approach	Environmental protection may move to "holistic" concerns and move away from single endpoint (health/cancer, eco/fish tox), regulations	Scientific input will have to involve a synthesis of views, a "shared vision" of what we know and what it means to feed into regulatory "valuation."	*IIIB*	*"New" approaches to management*

ID	*Title*	*Trend or event*	*Resulting environmental challenge*	*Break-out group*	*Group-assigned category*
178	Profit	Regulatory agencies make a change in how they do business. Business is leaner and staffed differently than the '80s without dedicated environmental employees (most business is not Fortune 500).	To develop the changes in a concise, easy to understand format so industry manpower can focus on ideas and implementation and not the interpretation of regulations. (We answer to most all agencies.)	*IIIB*	*"New" approaches to management*
179	Manpower -- keeping pace (at least)	With so many changes and new technologies (e.g., biotechnology) and rapidly expanding population, the ability for agencies and universities to keep pace is increasingly difficult.	We want to avoid/prevent surprises. How to strengthen the bonds among business, government and academia to ensure we're at least current instead of behind the rapidly emerging issues.	*IIIB*	*"New" approaches to management*
180	Computer analysis → new health issues	More data gathering and analysis on potential health impacts and exposures	Identification of new hazards/or redefining of old hazards (e.g., particulates and mortality; particulates and asthma).	*IIIB*	*Information*
181	Increased toxics information	Increased flow of information on toxic substances; i.e., no more "health trade secrets."	Increased use of toxic information for and by the public.	*IIIB*	*Information*
182	Packaging ideas	Advertising leads to consumption leads to pollution	Need for advertising good practices and relating environmentally sound ideas to the public, in order to get "buy in."	*IIIB*	*Packaging*
183	Packing	Product packaging contributes greatly to wastestream and pollution (land, air, water).	Need to find ways of reducing packaging or charging for disposal.	*IIIB*	*Packaging*
184	Profit	Turning the wastestreams into a product	To provide a market for viable products that incorporate wastes but cannot compete in the marketplace because of cost.	*IIIB*	*Profit*
185	Environmental immunogens; breakthroughs on the immune system	Clarification of how the immune system works and its interrelationship with external stimuli	Environmental immunogens. Indications of interrelationship between toxic exposure and infectious disease.	*IIIB*	*"New" tox issues*
186	Natural resource sustainability	Understanding rates of natural resource extraction from terrestrial and aquatic systems.	Be able to assess risks to sustaining California's natural resources due to increased demands (from population) and contamination (from waste disposal).	*IIIB*	*Natural resources*
187	Drinking water supplied	Understanding what risks are posed by chemical inputs, water management practices, etc.	Identify what actions are needed to protect water supplies in consideration of increasing population.	*IIIB*	*Natural resources*
188	Environmental gene regulators	Environmental modulators of gene activity (2nd messengers) will be discovered that influence cell function, differentiation ⇒ disease at extremely low levels of exposure	Genotox vs. non-genotox not relevant. All endpoints have common basis, therefore redefine risk paradigm.	*IIIB*	

ID	*Title*	*Trend or event*	*Resulting environmental challenge*	*Break-out group*	*Group-assigned category*
189	Genetic polymorphisms, mixtures, cancer pathogens	Information is accumulating that genetic polymorphisms in xenobiotic metabolism, which may increase the risk of cancers which are associated with environmental contaminants, appear to be ethnically related. This may also increase the risk from certain mixtures.	To obtain research information and be able to correlate it with areas of ethnic concentrations and make the information available to risk managers, without penalizing individuals because of their ethnic background.	*IIIB*	
190	Intergovernmental communication and communication with universities and business staff	Environmental regulations becoming increasingly dispersed to county and city government, but communication between these entities (or technical assistance) is not increasing. Communication between state governmental and university staff, which may provide needed research info and business which may provide info on new products and waste streams is not occurring.	How to increase communication and interaction when the time is probably not easy to justify in budgets based on widget counting, greatest risk, grant proposal requirements, etc.	*IIIB*	
191	Future risks from "gene flow"	Potential exists for "gene flow" from biotech research, development, and genetically engineered products.	To identify potential sources of gene flow, to identify possible future risks, to consider multi-agency panel (Cal/EPA-DHS-DFG) to prepare now to control future risks.	*IIIC*	*Future risks from "gene flow"*
192	Sustainable development	The trend is currently focused globally (particularly Southern Hemisphere), but will start becoming more focused locally (e.g., logging, agriculture, industrial)	Industry, government and environmental groups working together on resource/land management usage that benefits all. Learning to make compromises, but without detriments.	*IIIC*	*Not categorized*
193	De-regulation	State regs lessening and becoming more "federal" and less stringent and trying to be "politically correct."	Need to be focused on benefits to environment and public health, without trying to do what's right in the political environment (e.g., regulating agencies need to stand firm by their mission).	*IIIC*	*Not categorized*
194	Water quantity/water quality issues	Less available water and poorer quality; populations are increasing (resulting in) more use of water; environmental contaminants (resulting in) decreased quality; + residential reclamation system.	Costly, feasible? How would public respond.	*IIIC*	*Not categorized*
195	More flexible risk management institutions	Rapid pace of changes in knowledge and technology and ability of existing governmental agencies to respond rapidly and flexibly.	Developing new and more flexible management systems in environmental agencies.	*IIIC*	*Not categorized*

ID	*Title*	*Trend or event*	*Resulting environmental challenge*	*Break-out group*	*Group-assigned category*
196	Pollution prevention and small business	Small business is economic growth engine of California. In the future, a higher percentage of emissions will come from small companies.	How to identify pollution prevention opportunities for small companies (cost effective).	*IIIC*	*Not categorized*
197	Individual economic effects of climatic change	Catastrophic climatic effects may force a rapid phase out of carbon-based fuel with large economic dislocations. It can't be assumed these changes will occur slowly.		*IIIC*	*Not categorized*
198	Whole environment analysis	Multi-media, multi-chemical, watershed, etc. analysis	To find the best point of regulation not all point or non-point regulation.	*IIIC*	*Not categorized*
199	Source apportionment in impacted water bodies	303(d) listings require total maximum daily loads (TMDLs). [Clean Water Act has Section 303(d) requirements.]	New methods of environmental monitoring will be needed to know where we are, whether or not mitigation measures are working, and how long it will take to achieve an environmental goal.	*IIIC*	*Not categorized*
200	Site specific criteria	Emphasis is being placed upon sensitive subpopulations. Data necessary for site specific EIRs are needed and flexibility in regulations to maximize benefits of site.	Acknowledge variabilities in the environment and human behavior.	*IIIC*	*Not categorized*
201	Risk communication issues	Public will have less trust in the "government" and business; media should be trained on how to present environmental issues; students should be trained in high school about risk; if public was more aware of the risks/benefits, then they may trust government more, and government agencies could get more funding!	How do you communicate risk?	*IIIC*	*Risk communication issues*
202	Public perception of chemical Risks	Increasing availability of information about chemical toxicities and "releases" will heighten public's fear of health impacts.	Community-based risk communication, putting risks into context (including synthetic and naturally-occurring chemicals).	*IIIC*	*Risk communication issues*
203	Multiple chemical exposures	Despite our best efforts, we will fail to predict interactions of multiple chemical exposure (5-10 yr time frame)	How to assess risks of multiple chemical exposure in absence of understanding. How to reduce exposure to multiple chemical exposures.	*IIIC*	*Multiple chemical exposures*
204	Multiple chemical/agent exposures	Increasing complexity of exposures	How to identify/monitor for health effects; what are the alternatives to existing lab toxicity tests? Are there sentinel populations? Models? Other?	*IIIC*	*Multiple chemical exposures*

ID	*Title*	*Trend or event*	*Resulting environmental challenge*	*Break-out group*	*Group-assigned category*
205	Chemical effects on the immune system	Chemical exposure may be found to have more of an effect on the immune system than previously recognized. It is possible that chemical exposure or multiple chemical exposure may compromise the human immune system in ways not yet appreciated. This could result in increased susceptibility to microorganisms. At the same time, antibiotic resistance could make fighting human infections more difficult.	Identify chemical or chemicals responsible. Come up with better antibiotics.	*IIIC*	*Multiple chemical exposures*
206	Assessing "total" toxicity in waste samples	Combination(s) of chemicals, each at "non-detect" levels, produce toxicity (e.g., in bioassays -- minnows, algae, clams, daphnia, etc.) that has no apparent cause.	Identifying chemicals that could act in concert, either through additivity or synergism, that have the potential to cause observable toxicity when they themselves cannot be detected. (How receptor-based mode of action chemicals can be analyzed.)	*IIIC*	*Multiple chemical exposures*
207	Endocrine disrupters/consequences of breakdown products	Increasing use of prescription drugs containing hormone mimics -- birth control, HRT, etc. Drug companies developing new ones. Studies on effect on person taking the drug, but not what happens after it leaves the body.	What are breakdown products/waste products? Where do they end up? What are the effects on people/animals exposed?	*IIIC*	*Multiple chemical exposures*
208	Indoor environments	Growing body of information which indicates that indoor environments and individual human activities are important contributors to total exposure and risks, and modifiers of exposures and risks from outdoor environments.	Finding ways to integrate this component of the environment into our thinking -- changing the paradigm.	*IIIC*	*Indoor environments*
209	Generational pollution penalties	"Polluter pays," but do penalties reflect longevity of damage?	To develop "future generations" pollution penalties: the more future generations your pollution is likely to affect, the more you pay.	*IVA*	
210	Increased global mobility of disease	Increasing mobility of everything.	*Resulting environmental challenge*: Alien species transfers create: Disease transfer? Parasites? Other pathogens? Insect pests?	*IVA*	*Risk assessment*

ID	*Title*	*Trend or event*	*Resulting environmental challenge*	*Break-out group*	*Group-assigned category*
211	Non-lethal technologies	Law enforcement agencies are increasingly developing and fielding non-lethal technologies without consideration of the long-term/chronic environmental, safety and occupational health (ESOH) impacts of the use of these technologies.	Development of ESOH standards for non-lethal technology design and use.	*IVA*	*New product/technology evaluation*
212	Biotechnology	New products being available/marketable without appropriate product evaluation.	Avoid "fix it later" approach by establishing committee/dialogue/awareness of ongoing biotechnology products; design ways to effectively evaluate all aspects of these products.	*IVA*	*New product/technology evaluation*
213	Nuclear attack on California/Terrorist attack (bio-; nerve; nuclear)	Terrorists detonate nuclear device in populated, economically crucial area.	Given nuclear issues are in federal domain, how is Cal/EPA going to respond -- restore environment, feed the country.	*IVA*	*New impact issues*
214	Transportation gridlock	Strong economy, cheap EVs, increasing population combine to create massive congestion in SoCal never envisioned. Engineers unable to respond with more "road space."	How to move people and goods efficiently (time and resources). Disposal of MVs with plastic auto bodies.	*IVA*	*New impact issues*
215	Meteor shower	Meteor shower wipes out satellites affecting GIS- and GPS-based or linked systems.		*IVA*	*New impact issues*
216	Uses of municipal solid waste	Generation of municipal solid waste in constant increase. New landfills need to be open, closer to communities and/or using valuable land.	Develop uses for municipal solid waste, such as raw building materials, energy production, roads covering ("asphalt" component), etc.	*IVA*	*Conversion issues*
217	Storm and sanitary sewers vs. combined systems	Convert existing storm/sanitary sewers to combined or keep the way they are.	If combined -- larger wastewater treatment plants, possibility of overflow, cost of going from existing storm and sanitary to combined. However, storm water is degrading creeks and surface waters, so is combined more attractive option?	*IVA*	*Conversion issues*
218	Use of two-cycle engines in drinking water supplies (reservoirs)	Continue to use them or ban them and use four-cycle engines.	Example: Tahoe to ban two-cycle engines by end of year 1999. What to do with existing engines and new engines. Continue to use two-cycle engines can create MTBE contamination but how can all two-cycle engines be banned?	*IVA*	*Conversion issues*

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219	Mammalian immune system degradation/collapse	Increasing low-level, mixed media assaults raise background contamination above threshold of response for mammalian immune system.	Increased vulnerability to increasingly transferred disease, parasite, pathogens; "stimulated immune deficiency syndrome."	*IVA*	*Pollution issues*
220	Pharmaceutical residuals	Pharmaceutical chemicals in sewage sludge which is deposited in or on landfills and on agricultural lands/		*IVA*	*Pollution issues*
221	Roving particulate pollution	Increasing instability of weather leads to increasing drought, warm spells, fire problems -- smoke from elsewhere travels into state.	"Alien particulates" cause health problems.	*IVA*	*Global climate change related issues*
222	World production of CO_2	Increasing environmental levels of CO_2 are related to use of fossil fuels, population growth, consumption of animal meats, and decrease in volume of world photosynthetic forests. This process is likely irreversible.	To genetically manipulate, using biotechnology and genetic engineering techniques, plants so that they could: (1) increase the retention of CO_2, and (2) produce more carbohydrates for food consumption.	*IVA*	*Global climate change related issues*
223	Continued climate change and highway proliferation	Temperatures creep up; continued concretization of California turns cities into massive heat sinks; "thermal pollution" as average daily downtown temperature hovers @ 100^oF.	Increased medical problems due to heat exhaustion.	*IVA*	*Global climate change related issues*
224	Exotic species	Species that were not originally a part of our ecosystem will continue to arrive, due to our worldwide economy.	Instead of considering a new species as an enemy forever, find ways to evaluate its economic and public health impacts (if any) and then make use of it.	*IVA*	*Immigration (alien issues)*
225	Beyond ISO 14000	Industry is rapidly achieving ISO 14000 certification. However, a number of environmental management concepts are emerging internationally that will supplement/supplant ISO 14000. These concepts include "polluter pays," "intergenerational equity," "the precautionary principle," etc.	Challenge California to be the leader in developing the next generation of futures-oriented environmental management systems.	*IVA*	*Processes, approaches*
226	Wild goose chase	Increasing integrated risk and evaluating multiple exposures and endocrine disrupters may not be very productive. A simpler risk assessment may be good enough.	Do not expend our limited resource pursuing highly detailed and labor intensive methodologies when something less may serve.	*IVA*	*Processes, approaches*

ID	*Title*	*Trend or event*	*Resulting environmental challenge*	*Break-out group*	*Group-assigned category*
227	Results-based performance metrics	Government decision-making is increasingly being driven by short-term political factors, perpetuating the crisis-management paradigm and obstructing the implementation of a futures-based government system.	Creating a state government that runs on results-based performance metrics which include solution of, not just identification of, future environmental challenges.	*IVA*	*Processes, approaches*
228	Strategic environmental assessment	NEPA/CEQA activities are increasingly repetitive. Eventually, there will be an economy of scale realized by conducting environmental assessments at the programmatic or policy (not project) level.	Shifting NEPA activities to be oriented more on cumulative/coordinated impact assessments and on strategic-level assessments.	*IVA*	*Processes, approaches*
229	Remote viewing for environmental protection	Growing numbers of people are becoming able to sense remote events (separated both by time and by distance)	Development of low-tech/low-impact environmental monitoring/enforcement capability based on remote viewing technology.	*IVA*	*Processes, approaches*
230	Industrial ecosystems	Increased need for natural resources through (economic) growth, increased waste, etc.	Implement structure/program into current government (Cal/EPA, Resources) that will effectively identify, direct and assist with the development of industrial ecosystems and partnerships between opposing groups.	*IVA*	*Processes, approaches*
231	Public perception and actual contributors to health risk	General public is constantly increasing its demands for a safer, cleaner, and exempt (sic) of environmental and health risks.	To develop a holistic approach to health risk assessment (and/or public health) that quantitatively and/or qualitatively characterizes actual and less likely risks.	*IVA*	*Public involvement (a subcategory under processes, approaches)*
232	(no title)	Futures ecology	Get rid (of) spending resources on evaluating public health impacts for every chemical, process, industry, etc. Make every stakeholder (I hate that word!) define what they want and make them determine the risks associated with their wants.	*IVA*	*Public involvement (a subcategory under processes, approaches)*
233	Making tradeoffs among competing demands, where "benefits" not all of which can be expressed in monetary units and where there are equity-distribution issues	Increasing demands by consumptive and non-consumptive uses; increasing conflicts over resource management; issues of environmental justice	(1) Balancing economic, environmental, and social values; (2) Tradeoffs between ecology and economy, other benefits; (3) tradeoffs between need of people and needs of endangered species.	*IVB*	

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234	Prevention	End of pipe (control) environmental regulations too expensive, non-productive, ultimately not protective enough (due to increased population, standard of living, scientific data).	Environmental regulatory agencies must thoroughly integrate prevention approaches so as to reduce investments in non-productive equipment, O&M, future liability, etc.	*IVB*	
235	Sustainable environmental resources management	(1) Increasing demands for instream and offstream water from increasing populations, water uses, environment and ecology; (2) less money for infrastructure investments; (3) Less government regulation desired.	(1) How to achieve sustainable (long-term) water management of quantity and quality; (2) How to control or manage water demand all with less money and less regulation.	*IVB*	
236	(No title)	Making environmental policies and budgetary decision without adequate input from science community and people in the field.	How to develop/improve mechanisms to ensure statutory and budgetary decision, incorporate input from people in the "field."	*IVB*	
237	Communication	Agencies not being able to keep up with communication with other agencies or groups, and within the agency.	End duplication efforts and not knowing whose responsibility something is. This will lead to increased efficiency and less costs.	*IVB*	
238	Education	Will not be able to keep up with public education as the information becomes available -- despite the "information age."	Keeping the public informed and educated as EPA/science community finds new problems/solutions to emerging environmental issues.	*IVB*	
239	Education of constituencies -- public; public participation	There is a dearth of understanding of the underlying science of environmental issues and policies. To promote implementation, we need to develop a culling of understanding so that the public can participate, enthusiastically and on the basis of informed evaluations.	Address at level of school education -- K-12 and workshop.	*IVB*	
240	Public awareness/behavior	As long as "someone else" (i.e., industry) must assume blame, public wants environmental improvements. Tougher to get individuals to change behavior which seems insignificant individually but significant in the aggregate.	Need more complete data; K-12 environmental education.	*IVB*	
241	Pollution of space	Increased commercialization of space will result in an increased debris load.	Global cooperation to agree on policy.	*IVB*	

ID	*Title*	*Trend or event*	*Resulting environmental challenge*	*Break-out group*	*Group-assigned category*
242	Crisis prevention vs. crisis management	Old problem -- Little interest in preventing problems and doing what we are doing now -- trying to forecast potential problems -- compared to solving problems once they happen. Relatively short-time tenure of decision-makers vs. need for long-term planning and programming and research.	Mismatch of scientific and decision-making processes.	*IVB*	
243	(No title)	Continued or even greater demand for limited water resources.	How to make scientifically and politically balanced decisions rather than decisions solely based on politics.	*IVB*	
244	Sustainability of resource consumption by business industry	Use of non-resources and renewable resources continues to increase as a measure of economic strength, but will eventually collapse if sustainability is not placed into the mainstream of business and industry.	To promote sustainability via various incentives, and regulation and educational programs.	*IVB*	
245	Health assessment/regulation based on total/cumulative risks	Increasing attention on trivial, incremental risks, while neglecting major risks.	Include voluntary risks as well as involuntary (lifestyle, diet, health care, employment, income level) in assessing impacts/need for regulation.	*IVB*	
246	Cost-benefit: The “new” decision metric	(1) increasing emphasis on integration of bioenvironmental and social sciences, especially economics; (2) trend toward declining role of “risk assessment” sciences (“traditional”) in health/environmental policy-making; (3) URGENT need to anticipate unintended consequences.	(1) need to build partnerships/collaborations in which the principles, norms, methods, metrics, etc. are complementary (bioenvironmental and social science); (2) need to reverse “marginalization of bioenvironmental sciences; (3) need for cultural and normative changes within/among bioenvironmental scientists; (4) need to expand/extend “vision” for unintended consequences (both negative and positive...i.e., costly/risky and beneficial); need to turn “stakeholder participation” (environmental democracy) into a beneficial reality, not a necessary evil.	*IVB*	
247	Control of exotic species introductions	Continuing both in terrestrial and marine coastal environments in California. Exotic species will continue to alter California ecosystems.	Assessment, evaluation and mediation of the problem are all complex challenges, both technically and politically.	*IVB*	

ID	*Title*	*Trend or event*	*Resulting environmental challenge*	*Break-out group*	*Group-assigned category*
248	Systems Approach (multimedia, multi-agency) to Protecting Environment	Currently regulation within Cal/EPA is compartmentalized into various media and has resulted in problems of environmental management (example: MTBE and fuel). This compartmentalization continues throughout State government and the Resources Agency, transportation, and others should be included in the comprehensive evaluating of issues and development of appropriate regulations.	To create a systems approach in the consideration of environmental protection and management.	*IVB*	
249	End of "command and control"	Move away from focus on "solutions (i.e. technologies) looking for problems". . . toward focus on the problems, per se . . . and what's needed/wanted . . . incentives for innovation.	New/unfamiliar paradigms for everything . . . from goal-setting to enforcement; need for advanced and validated methods for comparative risk assessment (that incorporate all measures/metrics of "value).	*IVB*	
250	Environmental impacts of measures to reduce greenhouse gases	Much interest in reducing greenhouse gas emissions, not much thought to negative impacts. Increased nuclear power? Increased use of diesel fuel? Changes in nature of waste streams?	Do thorough analysis of unintended consequences of global climate change activities.	*IVB)*	
251	Consumer products	As we fine tune industrial sources of pollution, major contributor of environmental pollutants is from use and disposal of consumer products.	Nonpoint source controls (prevention again a potential tool): labeling (all, not just active ingredients); reformulation; environmental fate research.	*IVB*	
252	Eliminate water as a waste carrier	Treat/concentrate/recycle-reuse on site		*IVC*	
253	Endangered species	The extinction of a major food resource, e.g., salmon runs	Adapting to the pervasiveness of the impact -- changes in substitute food source; replacement species; replacement habitat -- new ecosystems, economic and cultural changes in way of life.	*IVC*	
254	Water	As California grows (50M by 2025, possibly), the strain on the water infrastructure and resources will be great.	Accommodate growth, agriculture and demand/need for clean, safe water.	*IVC*	
255	Reduce water for waste movement to POTW	Less water for increasing population	Identifying other media or (?) to transport waste; not creating a high volume new wastestream; stimulate pollution prevention and on-site waste treatment.	*IVC*	

ID	*Title*	*Trend or event*	*Resulting environmental challenge*	*Break-out group*	*Group-assigned category*
256	Behavioral and social change	Many problems are based on social "norm" or personal preference (personal auto, many convenience, keep up with Jones). Change is required to significantly improve environmental quality.	Moving culture from a "user" "capitalist" base (exploitation of resources) to a "contributor"(resource management holistically)-based society.	*IVC*	
257	Improve front-end evaluation of chemicals		Toxicity, environmental fate and transport, persistence, purpose, manufacturing, disposal.	*IVC*	*Regulatory*
258	"Ecotopia" vs. "Armpits"	Shift of resource uses and economic incentive lead to clean vs. dirty cities/counties; states that have vs. have-nots, e.g., non-sewage/stormwater	(1) How to remediate these recalcitrant communities -- keep people/industry there; (2) How to prevent new pollution/resource at the emerging ecotopias.	*IVC*	
259	(No title)	Greater incidence of water shortages in drought years due to: more demand; more variable climate.	mechanisms for reducing drought year demand; more storage ⇒ groundwater storage	*IVC*	
260	Expose "true" costs of resource choices	Internalization of externality establish policies that move to expose life cycle cost at point of purchase.	Removing subsidies, and increasing social responsibility for consequences of resource choices.	*IVC*	*Life cycle*
261	Environmental management systems	Industry, particularly those doing business in EEC, will need to be ISO 14000 certified. This requires a cross-media, industry or site-specific approach to environmental management.	Cal/EPA must create powerful integrating structures to address this (and similar) issues.	*IVC*	*Regulatory*
262	(No title)	Increasing biological invasions	Prevention ⇒ reduce the number of exotic species arriving; monitor and respond ⇒ track changes in biota, intervene <u>early</u>.	*IVC*	*Exotic species*
263	(No title)	Weather causes unprecedented need for increased chemical usage in crops		*?*	
264	Pharmaceutical release	As population ages, there will be increased consumption of new pharmaceuticals.	Release of these pharmaceuticals into ambient water will create potential problems for drinking water and wildlife.	*?*	
265	Fibers and fine particulates	Manufacturing processes are increasingly using exotic and compound fibers and generating fine particulates.	Identify the chronic human and ecosystem impacts likely to result from release of these fibers and fine particulates.	*?*	

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266	Indigenous genetic ownership	Increasing international concerns over "ownership" of indigenous genetic information is imposing and will impose restrictions on the use of such genetic info for environmental protection. Conversely, developments in genetic analysis are bringing to light genetic predisposition to sensitivity to certain classes of compounds.	Developing policies for protection of specific genetic populations. (Protection both from exploitation and from environmental exposure inequities)	*?*	
267	Detection limits	Developments in detection technologies are rapidly decreasing the limits of detection for various compounds. This leads to more and more info available for environmental decision-making, driving demand for control of compounds to increasingly lower limits.	Development of publicly accessible systems to handle the increasing detection/monitoring info-glut and tie that to other public info systems which support scientifically-sound environmental decision-making and regulation.	*?*	

Idea wall

It is interesting and exciting to discuss the environmental challenges facing us in the future. I applaud OEHHA for convening this workshop. I would urge that Cal/EPA focus equal attention on the regulatory structure changes that will be necessary to address the evolving challenges.

We are learning that our environment is far more complex than once believed. When rivers were burning and fish were dying due to lack of dissolved oxygen -- and receiving waters were often giant cess pools, a direct command and control approach worked very well. The nation and California have effected a positive change in most areas of the environment.

The challenge today and in the future will not only involve developing a better understanding of the stressors facing our ecosystem, but also to define a modified approach to addressing the complex system.

The current regulatory system is not flexible enough to allow for the future challenges we face. Identifying new problems is good, but how will we address them? Cal/EPA, and the State Water Resources Control Board are currently presented with a wonderful opportunity to develop State Plans that afford the flexibility necessary to adapt to this new era of environmental protection. Adding new concerns to existing ones will only over-burden the already clogged and resource limited system. Use of appropriate risk assessment processes that will allow re-allocation of resources to priority problems will be the key to a successful transition to a new era of environmental protection. Cal/EPA should take the lead in such an effort. It will not be easy, but it is essential.

A multitude of agencies have responsibilities to protect the environment -- and they often don't talk to each other. DTSC requirements often conflict with other regulatory agency initiatives. USEPA has difficulties coordinating with the U.S.F.&W.S. Regional Boards in California do not always coordinate well.

The goal of the various agencies should be to coordinate closely and come up with a unified vision of (and for) a particular watershed. The regulatory system must be flexible enough to develop "control plans" that may be different from other areas in the State, but consistent with approaches used elsewhere. Key elements of a new regulatory approach include:

Watershed Based Permitting

- Develop priorities within watersheds and sub-watersheds.
- Use of risk assessment tools that are designed to identify the largest problems, without defining an ultimate number on which to base compliance. (R.A. analysis is much more than dose, cancer risks.)
- The systems approach would focus on improvement.
- Use of ranges of potentially applicable endpoints that protect beneficial uses -- then define programs that move in that direction. This best addresses "uncertainty" and allows progress toward attainment.
- The system must de-emphasize resource allocation to those issues that have been 90 to 95% resolved.
- One of the greatest "risks" will be the attempt to develop a new approach to regulations. Acknowledge this risk as an essential element of necessary change.
- Develop a coordinated approach with all agencies that have environmental protection responsibilities, e.g., USEPA, Cal/EPA, USF&WS, Cal DF&G, DTSC, OEHHA.
- Keep communities involved, informed. Take the risk of creatively interpreting current laws and regulations -- or begin to change them to meet needs.

Summary

Regulatory evolution (not re-invention)

Hypothesis: Environmental protection is more complex than ever thought, and the regulatory system must be modified to address new knowledge and complexity.

Assumptions:
1. Resources to affect change are limited.
2. Improvements to the environment have been substantial.
3. Resources should be allocated to the highest priority problems in a watershed.
4. What works in one area may not be appropriate in another.
5. Current regulatory process is only beginning to move from command and control.

Key next steps:

1. Environmental protection must follow a systems approach. Acknowledge this and accept the risk that many people resist change.

2. Use risk assessment as more than an exposure → dose → response mechanism. Use it to define the largest or priority risks in a watershed.

3. Focus on improving the highest priorities. Don't waste effort and resources on defining what totally protects.

4. Use uncertainty analysis to define a range of defensible protection levels. Then focus on making things better when defining compliance.

5. Coordinate the various agencies that are responsible for protecting the environment.

6. Consider the following words/concepts when making changes: "Adaptable," Resource re-allocation.

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Cal/EPA should use its regulatory approach and activities in a manner consciously designed to provoke efficiency improvements that reduce or eliminate pollution -- rather than provoking further investments in end of pipe controls that are expensive, nonproductive, and ultimately not adequate to protect public health and the environment.

This means more efforts in pollution prevention, especially the integration of P2 into all aspects of Cal/EPA's programs.

***

USEPA
↑
Communication (i.e., share databases, know what the other is doing)
↓
Cal/EPA

***

DPR should regulate biotechnology.

***

Managing regulatory compliance with a unified and cost-effective systems approach that reduces environmental risks, exposure, paperwork and fees.

Meeting Cal/EPA standards, such as air quality, and simultaneously competing in a global economy with regions and locales that have a higher tolerance for pollution.

Providing the infrastructure to support growth from water treatment to education to transportation.

The regulatory agencies, the community and industry must work as a team. Issues include:

1. Educating the public to act from the basis of science and BACT instead of fear and a "not in my backyard" attitude and to recognize the importance of industry to the community.
2. Educating business to see the community as a part of the process and the ability to sustain long-term growth is superior to short-term profits.
3. Educating regulatory agencies that driving industry out of the area does not reduce pollution and technology is not always available to meet the goals.

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Cal/EPA should control exotic species.

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- Reporting good numbers, required for good models, should not lead to "backdoor" litigation.

- Changes must be applied equitably in order to compete.

***

I see environmental justice issues as the major issues. California must adopt principles of environmental justice that relate to the siting of facilities and public participation.

California needs to advocate for the development of renewable energy sources, including solar, wind, and water.

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Communities must be involved in all phases of these meetings no matter how technical the issues!!!

***

1. Safety of recharged groundwater
2. Earthquake toxic spill preparedness
3. Immunotoxicity and sensitization
4. Water quality and reproductive health
5. Global warning
6. Ozone depletion and UV exposure

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Please don't forget us.
I am the future.
We are the future.
- Paris, 4 years
- Ananda, 9 months

***

A fundamental determinant of future issues is the anticipated increase in population load in the inner cities, especially in Southern California. This will result in not only increased demand for natural resources and an increase in pollution in all media, but also competition for fiscal resources for remediation and compliance because of the need of fiscal resource for the added demands for health care and other social needs.

There will continue to be a need for streamlining regulatory requirements -- as in CUPA -- and providing small businesses with assistance in compliance with environmental regulations.

There will be an enhanced need to streamline remediation efforts, as with presumptive remedies used in Brownfields.

The desertification of areas like the Owens Valley, with its subsequent issues PM10 and social devastation, will need to be addressed and reevaluated in terms of whether these areas should continue to support the “growth” economy of a natural desert -- Southern California.

Marine life will be subject to increasing pollution from stormwater runoff unless measures are taken to enforce stormwater protection in the inner cities.

SUMMARY OF REPORTS BY THE BREAK-OUT GROUPS TO PLENARY

A representative from each break-out group presented the snowcard ideas that received the highest scores for his/her group. The group reports are summarized below; comments and questions which were prompted as a result of a group's report are incorporated into the summaries.

Day 1

Break-out groups on "Environmental Impacts of New Technologies"

Group IA, presented by Tracey Harper, California Integrated Waste Management Board:

New recycling or re-use. This issue relates to potential contamination of products derived from secondary materials, i.e., materials that are pulled out of the waste stream and recycled into, or used to manufacture, other things. There is a potential for contamination, for example, of products that are put into containers made in this manner.

Landfill liners fail. What will happen when, or if, the landfill liners fail in the state, resulting in groundwater contamination? The challenges are: how are to stop the leakage, to repair and restore the groundwater, and to redesign landfills. This creates an opportunity to take advantage of the heightened media attention to sell recycling and waste prevention activities.

Multiple chemical sensitivity, or third disease. Minuscule amounts of some chemicals have been studied and found to be destructive to animal and human immune systems. The challenge is how to monitor these chemicals and prevent exposures.

Water treatment. Treatment of waste water for reuse using chlorination can produce highly mutagenic chemicals from the reaction of chlorine with natural organic materials. There is a need to identify alternative treatment methods.

Group IB, presented by Lee Schull, New Fields

Biotechnology. This was the group's high impact idea, given the fact that California is a biotech leader. This is an industry that is just evolving and will soon result in many new industries. The environmental impacts of biotechnology -- how to assess the safety of products, how to deal with gene flow, how to apply the risk assessment paradigm to decision-making relative to biotechnology products, and other issues -- are just beginning to be thought about.

Public education. Cal/EPA needs to become proactive in developing programs to educate the public. The agency is getting too "far ahead" of the public's understanding of environmental issues.

New waste streams. New chemicals are associated with new industries. The challenges include controlling these new industries in order to deal with the regulatory issues associated with new waste streams.

One idea (one for the highest for its surprise element or unexpectedness) was the "mining" of landfills, and the regulatory issues associated with that. There are a lot of resources that are discarded as waste, ending up in landfills, and the idea is that these can be recovered.

Group IC, presented by Terry Surles, Lawrence Livermore National Laboratories

Lack of comprehensive analysis. Rather than being continually worried about the end of the pipe, clean-up, or otherwise resolving problems, there is a need to fully evaluate the range of potential impacts of products or industry. Better manufacturing processes will control pollution before it occurs, and make better use of resources. This is something that will be driven more by private industry, and will likely involve new technology. How will some of these new technologies penetrate the market place? Can government provide incentives? Can government evaluate impacts with a cross-media perspective?

Transportation fuels/additives. An increased population will increase demand for the flow of goods and people. Fuels and fuel additives, their combustion products, their movement across media, and associated issues will need to be considered. Comparative life cycle analyses will be required.

Public involvement. California and Cal/EPA need to improve their communication with the public. The demand for public involvement in environmental decision-making by government is increasing, especially in the choice of technologies. The public's concerns need to be addressed, while still developing scientifically sound and economically feasible technological solutions to environmental problems. Information about what science can and cannot do, and what uncertainties can and cannot be resolved should be clarified in ways that are understandable to the public.

Deregulation. The future impacts of the deregulation of the electric industry are unknown. What impacts may be associated with new technologies entering the market as a result of deregulation? Will the increased competition lead to more environmental "short cuts"?

*** * ***

One workshop participant commented that Cal/EPA should improve its efforts to develop leadership throughout the entire agency, and to develop trust.

An additional comment was raised about the need for Cal/EPA to establish an ongoing, mechanism to ensure that future issues will be considered, regardless of changes in the State administration. There have been occasions where future issues had been effectively identified in a forum, but the responsible agencies have failed to act on such warnings. The commentor pointed to MTBE (methyl tertiary butyl ether) in oxygenated gasoline as an example of an issue for which indications that the chemical can contaminate groundwater, from studies conducted fifteen years ago, did not appear to be considered.

Joan Denton (OEHHA Director) assured the participants that OEHHA will follow up on the workshop, but cautioned that resource limitations should be kept in mind. Peter Bishop noted that Cal/EPA is obviously taking a risk by convening this workshop; it is raising expectations that it will act in a future-oriented manner. He added that for Cal/EPA or OEHHA to be successful, they should be able to count on the support of those present at the workshop, as well as other interested parties.

Break-out groups on "Sources, Releases and Transformations of Chemicals"

Group IIA, presented by David Morry, Office of Environmental Health Hazard Assessment:

Drugs in wastewater. With an increasing, aging population, there will be more excreted human and veterinary drugs that are not broken down at wastewater treatment plants and can enter drinking water sources. There is a need to monitor and conduct risk assessments on low levels of human drugs and veterinary drugs and to consider adverse drug interactions between the drugs that might enter drinking water and the drugs being taken by people drinking that contaminated water. In effect, we will not only be taking drugs prescribed by our doctors, but also inadvertently taking drugs as drinking water contaminants.

Cumulative effects. The increased use of chemicals in processes, products and residuals will lead to the need to assess the cumulative health and environmental effects of the increased number and amount of chemicals entering the environment.

Urban agricultural interface. Farms and communities have been growing closer together, resulting in the narrowing of the interface between agriculture and urban areas. There are increasing requirements for farmers to retain the materials that they use on the farms and not let these pollute the communities. There is an increase in what the communities expect from the farmers in terms of not letting materials affect them; at the same time, the communities expect the farmers to produce more and better food at lower prices. There is a conflict between what people expect of agriculture and the demands that they place on it.

Group IIB, presented by Yoram Cohen, University of California at Los Angeles:

Toxic transformation products. This is representative of the issue of transformation products. The challenge is to develop an approach that will consider both parent and daughter products, and to establish a regulatory program that considers total risk. From a scientific viewpoint, a systematic approach to identifying toxic transformation products and characterizing the transformation process needs to be developed.

Integrated regional risk assessment for forecasting pollution. As with the previous issue, this one also represented a number of other ideas that were expressed. Environmental issues need to be viewed from a broader perspective – e.g., in looking at air pollutants, one should also examine impacts on the terrestrial environment, on the watersheds, and others. A more holistic assessment (perhaps using a tiered approach) that can be applied to every chemical.

Global changes. If weather pattern changes lead to increased in precipitation, as in fact they have California, there may be resultant ecological and human health impacts that perhaps can increase in frequency in the future. Global changes affect the local environment, and vice-versa.

Group IIC, presented by Robert Howd, Office of Environmental Health Hazard Assessment:

Humans as pollution sources. With the human population increasing, human releases will become major pollutant sources (e.g., feces, chemicals in urine, exhaled substances, noise, allergens, hair and dander, lint from clothes, chrome from shoes, etc.) How do we avoid human impacts on the environment without turning into a police state?

Secondary impacts of drugs. An aging population will be taking more drugs, and current sewage treatment systems may not remove chemicals (drug metabolites) excreted in human wastes. Discharging these chemicals into the environment may have unanticipated impacts on aquatic organisms and other wildlife.

Businesses as environmental leaders. Cal/EPA will need to promote the natural tendency of businesses to do well financially. As businesses realize the economic self-interest in redesigning products and processes, Cal/EPA and the environmental community must learn to communicate about environmental issues in the language of business.

Day 2

Rather than assigning subject areas to the break-out groups as was done on the first day, workshop participants were asked to think about any future environmental challenges for Cal/EPA.

Group IIIA, presented by Robert Howd, Office of Environmental Health Hazard Assessment:

International cooperation in environmental protection. Cross-national pollution is an important issue for California, which is affected by pollution moving to and from Mexico and Canada. An innovative approach to address cross-national pollution is to "forgive" national debt, and allow the debtor country to instead use the money for pollution control facilities.

The end of hazardous wastes. The widespread application of industrial ecology, encouraged by Cal/EPA regulations, can result in all "wastes" generated by any given facility to be utilized by another.

Change in lifestyle to protect environment; give up convenience for environmental sustainability. Industrial ecology, car pooling, waste recycling, separate water supplies for drinking, cooking and other domestic uses {not clear}, non-water carried waste transport systems are various ways of promoting sustainability. The challenge is to create technology to promote and create convenience, without environmental degradation.

Group IIIB, presented by Brent Takemoto, Air Resources Board:

Intergovernmental communication and communication with universities and business staff. There are many layers of government that are regulating the business community, and there are also good ideas that may come from government staff, academia, and the business community. The challenge is for Cal/EPA to establish a framework to get these groups communicating and collaborating to formulate solutions.

Genetic polymorphisms, mixtures, cancer pathogens. In the coming years, it will be possible to identify ethnic-related differences in cancer risk due to new chemicals. With that information available, the challenge is to use it to develop environmentally justifiable or equitable decisions that take into account the additional risks posed due to genetic (ethnic) differences in population mixtures across the state.

Environmental gene regulators. A new group of chemicals that modulate gene activity will be discovered; they influence cell function and differentiation, causing disease at extremely low levels of exposure. The challenge is to alter existing(or develop new) risk management paradigms that balance genotoxic and non-genotoxic stressors.

Group IIIC, presented by David Morry, Office of Environmental Health Hazard Assessment:

Risk Communication Issues. The public will have less trust in government, industry and business. The media should be trained in how to present environmental issues. Students should be taught in high school about risk. If the public is more aware of risks and benefits, they may have more trust in government; governmental agencies could receive more funding. The challenge, then, is how to communicate risk.

Multiple chemical exposures. Despite our best efforts, we will fail to predict the interactions of multiple chemicals. The challenge is how to assess the risk of multiple chemical exposures, in the absence of complete understanding, and how to reduce exposure to multiple chemicals.

Indoor environments. There is a growing body of information which indicates that indoor environments and individual human activities are important contributors to total exposure and risk, and are modifiers of exposures and risks from outdoor environments. The challenge is to find ways to integrate this component of the environment into the risk assessment paradigm.

Group IVA, presented by Tracey Harper, California Integrated Waste Management Board:

Light pollution. Increasing urbanization and temporal distribution of human activities is leading to increasing light pollution, which impacts both human health and wildlife. The resulting environmental challenge is how to address the chronic human and ecosystem health issues associated with human activities which generate light pollution.

Generational pollution penalties. The "polluter pays" theory should reflect the longevity of the environmental damage. We should develop a "future generations" pollution penalty, in that the more future generations that the pollution is likely to affect, the higher the penalty the polluter pays.

Increased global mobility of disease. The mobility of everything is increasing. Alien species transfers create disease transfer, parasite transfer, and the transfer of other pathogens, insects and pests. These will need to be addressed.

Group IVA, presented by D. Peter Loucks, Cornell University:

Environmental impacts of measures to reduce greenhouse gases. Efforts to reduce global warming, will probably require new technologies. The environmental impacts of these measures should be evaluated, rather than simply focusing on greenhouse gas reduction.

Consumer products. As point source pollution is reduced -- from industry, from domestic sources, and even from agricultural sources -- the impact of consumer goods will become increasingly important.

End of "command and control." There is an increasing desire to do away with command and control, in the sense of an agency specifying how to achieve a particular performance standard. There is a need to create incentives for innovation, cooperation and economic efficiency.

Systems approach to environmental protection. Multimedia, multi-agency, coordinated efforts at environmental protection are needed. Current regulation is compartmentalized into various media, and has resulted in problems.

Group IVC, presented by Keith Smith, California Integrated Waste Management Board:

Increasing biological invasions. Efforts will need to be directed toward preventing the invasions, monitoring and tracking changes in biota, and intervening early.

Water shortages. The impact of water shortages is severe, yet we only seem to adapt during the drought years. The challenges is to establish mechanisms for reducing drought year demand.

Environmental management systems. Industries, particularly those doing business or selling to the European community, are increasingly working on the introduction of environmental management systems (e.g., ISO 14000 series). These are cross-media, integrated approaches to environmental management. Cal/EPA must create powerful integrating structures to address this kind of development, instead of having five or six agencies.

APPENDIX F

Workshop Attendees List

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Bobbie Garcia
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Chevron Products

* Speaker

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Trade and Commerce Agency

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Inside Cal/EPA

Helen Kennedy
Puget Sound Townkeeper Alliance

Susan Knadle, Ph.D.
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Brett Koeing
ICF Kaiser

Rob Kull
Montgomery Watson

Arthur Lawyer
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Stanton Lovre
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Gerald McEwen
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